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SOME FURTHER OBSERVATIONS ON SCIATICA.¹

By NORMAN LITTLE,
Sydney.

SCIATICA has been receiving considerable attention during the last few years, and this is due to the amount of study that has been devoted to lesions of the intervertebral disk. The time has arrived when the terminology relating to the conditions which cause the symptom of sciatica should be revised, for the name is not that of a disease but of a symptom-complex. It is, therefore, understandable that the importance of the causation of the symptom varies with the nature of the practitioner's speciality, and I shall present the subject as it affects my experience.

Historical Aspects.

The first complete description of the condition was made by Cotunio in the middle of the eighteenth century, and for many years it was known as Cotunio's disease.⁽¹⁾ He, by the way, was the first to describe the cerebro-spinal fluid—Cotunio's fluid. Charcot drew attention to the association of sciatica with vertebral deformities, while Brissot coined the term "sciatic scoliosis".⁽²⁾

About forty years ago some attempt was made to bring from obscurity the true nature of sciatica, the symptom. The French school of neurologists essayed to localize the site of nerve irritation, and referred to radiculitis, ganglionitis, funiculitis, plexitis and neuritis. They tried, but unsuccessfully, to discover syndromes for every one of the above-mentioned conditions. Twenty years ago Putti⁽³⁾ championed the cause of funiculitis—irritation of

the nerve as it lies in the intervertebral foramen—and ascribed it to changes in the nature of a degenerative arthritis of the smaller intervertebral joints in the lower lumbar region of the spine. A frequent cause of this form of arthritis, Putti asserted, was an anomaly of articular tropism, which means that the plane of the zygapophyseal joints is asymmetrical.

The next advance was the discovery of the frequency of herniation of the *nucleus pulposus*, which led to the recognition of the ruptured intervertebral disk without herniation. In 1857 Virchow described the tumour bearing his name—*ecchondrosis physaliphora*—and in 1895 Ribbert reproduced Virchow's tumour by puncturing the intervertebral disks of rabbits. In 1896 Kocher reported a case of rupture of an intervertebral disk in a man, aged twenty-six years, who fell 100 feet, landing in a standing position. He died in a short time from internal injuries.⁽⁴⁾ Autopsy revealed a rupture of the intervertebral disk between the first and second lumbar vertebrae without fracture. In 1911 Middleton and Teacher reported the case of a man, aged thirty-eight years, who felt something "snap" in his back while lifting a heavy weight, and was unable to straighten himself. The same night he felt as if his legs had become dead and he could no longer move them. He had a complete flaccid paralysis of the lower extremities with anaesthesia to the level of Poupart's ligament, along with incontinence of urine and faeces. He died of urinary infection, and at autopsy a posterior herniation of the disk between the twelfth dorsal and first lumbar vertebrae was found.⁽⁵⁾ Also in 1911 Goldthwait reported the case of a patient who developed flaccid paralysis of the legs after a manipulation of the spine under anaesthesia. At operation performed by Cushing no abnormality was found except some narrowing of the spinal canal at the lumbo-sacral junction. The patient made a slow partial recovery after the laminectomy. The cause of the symptoms was considered to be a rupture of an intervertebral disk,

¹Read at a meeting of the New South Wales Branch of the British Medical Association on July 26, 1945.

and Goldthwait suggested that other cases of paraplegia, lumbago and "sciatica" might be due to pressure on nerve roots by a displaced intervertebral disk.⁴⁰ During the last twenty years a considerable amount of work has been done in relation to the intervertebral disks.

Types of Sciatica.

There are two types of sciatica from the clinical point of view—one in which there are no neurological signs, and the other in which neurological signs are present.

1. Sciatica without neurological signs is secondary to some change in any of the tissues from the skin down to the bones and joints of the lumbar part of the spine; the pain is referred, and may originate in a small hæmangioma of the skin, an area of fibrositis in the fasciæ, the joints of the lower end of the spine, especially the lumbo-sacral and sacro-iliac joints, or the posterior part of the *annulus fibrosus*. The latter is well supplied with sensory nerve endings.⁴¹ Most of these conditions can be diagnosed readily; but to differentiate between an early lesion of the lumbo-sacral disk, in which there is only moderate damage to the *annulus fibrosus*, and a lesion of the lumbo-sacral zygapophyseal joints is difficult.

2. Sciatica with neurological signs can be subdivided into two sub-groups. The first is true sciatic neuritis, which may be infective, or due to some metallic poisoning or to some disturbance of metabolism. In my experience, this type of sciatica is rare. The second type is sciatica due to some disturbance of the roots of the lumbo-sacral plexus or of the nerves themselves. The causes generally accepted as responsible are arthritis of joints at the lower end of the spine, infection, newgrowth, sacralization of the fifth lumbar vertebra, spondylolisthesis, prolapse of an intervertebral disk, thickening of the *ligamentum subflavum*, radiculitis, inflammation and newgrowth inside the spinal canal.

I think changes in one or more intervertebral disks are the primary cause of the symptom of sciatica in most cases. How does a ruptured or degenerated disk, if there is no herniation, cause irritation of a nerve root? As the *nucleus pulposus* is situated much more towards the posterior part of the intervertebral space, it is easily appreciated that there will be more collapse of the space in this region when the *annulus fibrosus* is no longer able to contain the semi-fluid elastic nucleus. In the great majority of cases the posterior rim of the annulus gives way on one or other side of the mid-line, so the collapse of the intervertebral space is really posterolateral. What happens to the *ligamentum subflavum* in this event? Its two attachments are approximated, and when its structure is considered, it is obvious that it must bulge in some direction. I submit that it increases its antero-posterior thickness, and, if this state is maintained sufficiently long, secondary changes take place, which ultimately lead to fibrosis. Besides the changes in the *ligamentum subflavum* there will be those in the zygapophyseal joint on the same side; the latter will react by the usual method of a joint that has been strained—an effusion will be present and thickening of the joint capsule will occur. This probably represents the picture in those patients who have been operated upon and in whom no disk lesion was found; it is most likely that the disk bulges when the patient is in the upright position. The patient with this condition would be expected to be more comfortable when lying down than when upright, and at operation the affected disk should admit the tip of a pair of forceps with little effort on the part of the surgeon. When these changes are present, there is almost certainly some irritation of one of the spinal nerves; naturally it will not be so pronounced as in those patients in whom a large posterior herniation of the disk is present, but there should be some dysæsthesia in the corresponding dermatome. If symptoms have been present for some months, hypæsthesia will be found, while in the early stages of the lesion hyperæsthesia is frequently encountered. The surest way to demonstrate the disturbance of sensation is by running the point of a pin round the circumference of the limb at different levels;⁴² intelligent patients

readily recognize the change from normal to abnormal, once what is wanted is explained to them. The dermatome can be easily mapped by this method, and it invariably corresponds to the site of the pain experienced by the patient. In all these cases the nerve involved is the nerve that leaves the spinal canal through the foramen below the damaged disk,⁴³ and not the nerve leaving the canal through the foramen at the level of the affected disk.⁴⁴ For example, if the disk between the fifth lumbar vertebra and the sacrum is herniated or ruptured, the first sacral nerve is the nerve that is the seat of the traumatic radiculitis. In the lower lumbar region the spinal nerves course inside the canal within their covering of *dura mater* for a considerable distance after they leave the *cauda equina*, and that part of the nerve just proximal to the posterior root ganglion lies between the intervertebral disk anteriorly and the *ligamentum subflavum* posteriorly. At this site a well-defined venous plexus surrounds the nerve, and it is likely that interference with this causes the radiculitis in some cases.

From what has already been said, it can be understood that a disk lesion can start as backache, then cause a referred pain in the lower limb—that is, without neurological signs—and then be responsible for radiculitis, and all this without the classical posterior herniation of the contents of the disk. In my experience patients with this state of affairs suffer moderate pain when compared with those who have a large herniation of a disk, for the latter suffer severe pain and often need morphine to obtain relief.

These changes that have been described are encountered most frequently in males doing active work; but they can occur in anybody. Why, then, are the fourth and fifth lumbar intervertebral disks damaged more often than the others? It is the result of faulty mechanics. If we compare the lumbo-sacral region of man with that of a quadruped, we shall see that in the latter the sacral and lumbar regions are practically in a straight line, whereas our lumbar region on the average is tilted back 30°; this means that an excessive strain is thrown upon the posterior part of the lower lumbar intervertebral disks, which are necessarily wedge-shaped quadrilaterals, instead of on the more nearly rectangular disks in the upper lumbar and lower dorsal regions of the spine. Nature is trying to overcome this deficiency by sacralizing the fifth lumbar vertebra in some people and thereby shortening the lumbar portion of the spine; her work is far from complete, and I have been impressed by the number of patients with varying degrees of sacralization of the fifth lumbar vertebra who have suffered from lesions of the disk between the fourth and fifth lumbar vertebrae.

At this point I should like to mention that I agree with those who hold the opinion that congenital abnormalities in the lumbo-sacral region are not the cause of symptoms, except in so far as they are conducive to secondary changes in the lumbar part of the spine above themselves.

Admittedly, it is most important to determine where in its course the nerve is being irritated; but the possibility that the pain in the leg is referred pain from an area of fibrositis must not be forgotten. In fibrositis there are three common "trigger" points in the vicinity of the gluteal region, which can be responsible for a pain felt in the area supplied by branches of the sciatic nerve. One of these points is situated just lateral to the sacro-iliac joint, another is found about two inches below the highest point of the crest of the ilium, while the third is at the upper margin of the greater trochanter. The test in these cases is, of course, the local injection of "Novocain", which is followed by complete relief from pain. Unfortunately I do not know how it is possible to find the exact spot at which the nerve irritation is occurring; but if the course of the nerve roots taking part in the formation of the lumbo-sacral plexus is kept in mind from the spinal cord to the periphery, such conditions as a tumour of the spinal cord or of the *cauda equina*, tabs, affections of the pelvis and tumours or other conditions involving the sciatic nerve in the thigh, will not be so readily overlooked as they have been.

Symptoms.

The symptoms of sciatica vary considerably in intensity; the pain may be mild and may not interfere a great deal with the patient's activities or sleep, while at the other extreme morphine may be needed to obtain some relief. At first the pain is usually described as occurring in the hip, and the gluteal region is indicated by the patient; it then radiates into the thigh, and the patient frequently runs the points of his fingers along the postero-lateral aspect as he describes the location in this area. In some cases the pain does not radiate below the knee, but in most it does, and then the site of pain is described as being on the posterior or lateral aspect. Occasionally pain radiates to the foot and is felt on the outer side or dorsum in the majority of cases. When the pain is described as occurring in the areas mentioned, and it is decided that the pain is not referred, it is probably due to irritation of the fifth lumbar or first sacral nerve root. If the fourth lumbar nerve is the seat of irritation, the gluteal pain is higher, while in the thigh it runs obliquely downwards and forwards from the lateral aspect about two inches below the crest of the ilium to the front of the knee in the region of the patella; in the leg it continues down the antero-medial aspect and reaches the foot on the inner side. For more details of the sensory distribution to the skin of the lower limb I would refer the reader to Keegan's original article in *The Journal of Bone and Joint Surgery*, of April, 1944, and to make my remarks more intelligible I have borrowed his diagram⁽¹⁾ (Figure 1). If reliance has to be placed on the involved dermatome for the localization of a damaged intervertebral disk, it is well to remember that the lumbo-sacral plexus may be prefixed or post-fixed.

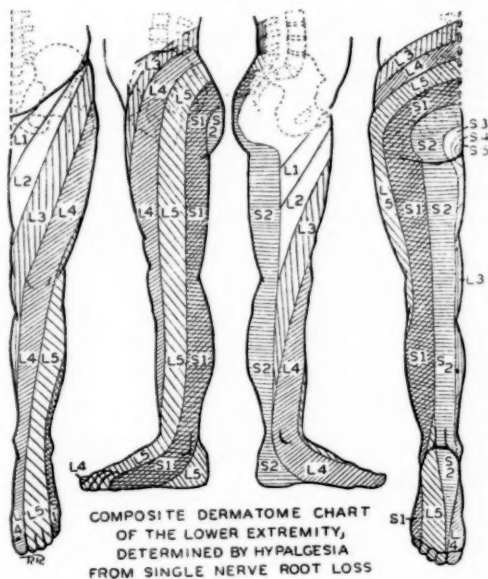


FIGURE 1 (after Keegan).

A typical history of a patient with sciatica, as encountered in my own practice, is as follows. A healthy, well built male, aged between twenty and forty-five years, is lifting a weight when he feels "something go in his back". As a rule there is no immediate pain; but within a few hours his back feels sore and movements hurt him. He finishes his shift or period of duty and retires to bed at the usual hour; next morning he experiences difficulty getting out of bed, but a hot shower may relieve him. He goes to work, but has to stop because of the pain in his back. The latter may improve with rest and allow him to return to work within a week; or three months off duty may be

necessary to restore him to the degree of comfort compatible with his occupation. The same thing happens at some time in the future, and on this occasion he is not so fortunate, for either at once or a few weeks later the pain begins to radiate, first into the gluteal region, then into the thigh and later into the leg and foot. In some instances the radiating pain appears immediately after the original injury and may be confined to the limb without any preceding or concomitant backache; but this latter event is the exception. Although the foregoing description is that most frequently encountered, there are many variations. By many patients the information is volunteered that coughing, sneezing and straining at stool aggravates the pain. The initial injury is not necessarily sustained while lifting; a fall, especially on the buttocks, a false step, a mis-hit at golf, and a sudden twist of the body to avoid being struck by something are some of the conditions that can bring on the train of symptoms. In a person with a previously ruptured disk, the act of bending to pick something up will initiate the attack at times. In older people the telalgia is more apt to occur without an injury, but it can still be due to a lesion of an intervertebral disk which has shared in the degenerative processes almost invariably seen in the lumbar portion of the spines of those of advanced years.

Physical Signs.

As in the symptoms, so there are variations in the physical signs from slight changes to those seen in extreme cases. In a moderately severe case an apparent scoliosis is present, the trunk listing either away from or towards the painful side. The patient takes his weight on the unaffected leg and stands with the involved limb flexed at the knee and hip and the heel off the ground. Loss of tone and wasting of the gluteal, thigh and leg muscles will be apparent, if the symptoms have been present for more than a few days. The lumbar lordosis is lost. All spinal movements are limited, and there is an increase of the pain on homolateral bending in most cases and on contralateral bending in a few. Superficial tenderness is absent, but deep tenderness over one or more intervertebral spaces on the involved side is almost certain to be present; if, as well as deep tenderness, pain is felt in the corresponding dermatome—by that is meant the area of skin supplied by the nerve which leaves the spinal column through the intervertebral foramen below the tender disk—a lesion of the intervertebral disk can be diagnosed with confidence. In these circumstances there is nearly always some disturbance of sensation in the affected dermatome; it may be hyperaesthesia in the early stages and hypaesthesia in the later. If the first sacral nerve is involved, the ankle jerk will be absent or diminished, and involvement of the fourth lumbar nerve will have a similar effect on the knee jerk. However, from what has been said about the stages of the disk lesion, it is apparent that these areas of pain can be present without any changes in the tendon reflexes, or, for that matter, without any disturbances in sensation. When merely a rupture of the posterior part of the *annulus fibrosus* has occurred, the pain in the limb may be entirely referred, but occasionally in this type of lesion deep pressure over the involved disk will increase the pain or cause some paraesthesia in the thigh or leg. Of all the signs mentioned, the one which we call the "thumb sign" is the most useful; it is the test for radiating pain when firm pressure is made over an intervertebral space about one inch from the midline. The easiest way to apply this pressure is with the patient lying prone on a low couch so that the examiner can bring to bear all his weight to his extended thumb; the result of the test is considered positive, if pain or paraesthesia is felt to radiate into some part of the corresponding dermatome. If the result is positive, and if the patient considers that his symptoms warrant it, an exploration of the disk is carried out.

There are two other signs that have not been mentioned; one is Lasègue's sign and the other the head flexion test. The former is always present when there is interference with the shape or course of the sciatic nerve, and its characteristics are well known. The latter is not so

extensively used, and is carried out in the following manner. The patient lies supine, and with one hand the examiner lifts the painful limb as in Lasègue's test until pain is felt, when the straight leg is lowered slowly until the pain first eases; then, with the other hand, the head is flexed so that the chin approximates the sternum; the result is considered positive if the pain in the leg is reproduced.

X-Ray Examination.

The examination must include X-ray films of the lumbosacral and lower lumbar regions of the spine. By this means the acute and chronic infective lesions of the spine, primary and secondary malignant disease of the vertebrae *et cetera* are excluded. In the great majority of cases the radiographer's report will contain the hackneyed sentence: "There is evidence of spondylitis in the lumbar and lumbosacral regions." However, if the films have been exposed with the tube centred over the lower lumbar part of the spine, a careful examination will reveal some change in the involved intervertebral space. There is some diminution to be seen in many instances. Normally the lumbosacral intervertebral space tends to be narrower than the spaces above; but if the body of the fifth lumbar vertebra appears to be displaced posteriorly, it is safe to assume that the narrowing is due to some extent to a collapse of the disk (Figure II). Naturally the changes observed in the X-ray films are never considered apart from the physical findings.



FIGURE II.

A tracing of an X-ray film, showing congenital narrowing of the lumbosacral intervertebral space and an acquired narrowing of the fourth lumbar intervertebral space. In the former there is no displacement posteriorly of the fifth lumbar vertebra, while in the latter the tail-tale displacement is present. This displacement depends on the plane of the articular facets, and is therefore not always present.

Treatment.

Now let us consider the most important feature of the symptom-complex, sciatica, which to the patient is the only thing that matters—the management of the condition. After all the other causes of sciatica have been ruled out, and when I am convinced that the case is one of traumatic radiculitis, I employ (but not necessarily in the order given) the following methods: manipulation of the spine under anaesthesia, bed rest with leg traction, the flexion jacket and operative removal of a damaged disk.

For those patients with severe pain and all the signs I have mentioned, complete bed rest with a weight of eight pounds attached to the painful limb is instituted as soon as possible: if there is no relief at the end of two weeks, a carefully performed manipulation is carried out under full surgical anaesthesia. Two precautions are necessary; the movement of flexion must be performed with great gentleness, and if there is any doubt, it should be omitted, while the movement of hyperextension is best carried out by lifting the patient with the surgeon's hands interlocked under the lumbar region. Rotation of the spine is done with the patient lying on his side; one of the surgeon's

hands forces the upper shoulder away from him and with the other forearm he thrusts the upper part of the pelvis towards himself; this manoeuvre is repeated with the patient lying on the opposite side. After this freeing of the lower part of the spine, the patient is again placed in the supine position; one lower limb is flexed at the knee and hip so that the former approximates the thorax; then, holding the limb just above the ankle with one hand and below the knee with the other, the surgeon forces the flexed limb back onto the trunk so that the pelvis is rolled forwards slightly, and from this position the limb is suddenly extended in such a way that traction is applied sharply and momentarily to the extended leg; this part of the procedure is repeated four times with each lower limb. After this the surgeon applies traction to both legs at once while the assistant pulls in the opposite direction on the shoulders. Physical therapy is contraindicated after these manipulations, and the patient is advised that it may be six weeks before the full benefit is felt.

If there is no improvement at the end of that period, or if the symptoms are obviously wearing the patient out, a flexion jacket is applied, but only if the patient obtains relief by leaning forward with his hands resting on something, like a table, which reaches to his mid-thigh; this position produces a slight kyphosis in the lumbar region and should stretch the *ligamentum subflavum*. The jacket is applied with the patient standing in this position; posteriorly, it covers the back from the lower angles of the scapulae to the middle of the sacrum, and anteriorly it should reach the *symphysis pubis* below. The cast needs trimming in the groins to allow full flexion at the hips. Within reason it is worn for as long as improvement continues and until relief is obtained. If symptoms recur after its removal, but are not severe enough to warrant operation, a special brace is ordered to maintain flexion of the lumbar part of the spine.⁽⁴⁾

If symptoms persist, or if they are severe, the need for surgical removal of the ruptured disk is discussed with the patient. Before the operation is performed, an estimation of the total protein content in the cerebro-spinal fluid is made; if the figure is high, the patient is referred to the neurosurgeon, but if the figure is compatible with a lesion of an intervertebral disk, the latter is removed.

It is still being debated by surgeons whether the spine should be fused or not after the damaged disk has been removed. Some surgeons believe that fusion is obtained by removal of as much *nucleus pulposus* as possible; I doubt very much whether sound ankylosis is procured by this means. Other surgeons state that it is not necessary to perform a spinal fusion unless there is some orthopaedic indication for it. In my own experience the results in those cases in which a spinal grafting operation was performed at the time when the disk was removed have been better than in those in which no graft was used, and in which an attempt was made to remove the whole of the *nucleus pulposus* as well as some of the *annulus fibrosus*. At present my practice is to remove all the *nucleus pulposus* possible with curettes and a pituitary punch and then pack the cavity with bone chips; this necessitates a longer period in bed, and when the patient is allowed up he should wear a reinforced lumbar belt. Before the bone chips are packed into the cavity, bare bone must be felt over an area almost the size of a shilling on the upper and lower surfaces of the adjoining vertebrae; by this means it is hoped to produce bony ankylosis between the vertebral bodies as well as to prevent the *nucleus pulposus* from regenerating. Even when no attempt is made to fuse the spine after removal of a ruptured disk, I am sure it is wrong to allow these patients on their feet during the first two weeks; healing must be allowed to take place, especially in the *annulus fibrosus*, to avoid strain of the zygapophyseal joints.

Prognosis.

It is impossible to give an exact figure for the end-results of the treatment of sciatica, because so many factors are involved, and in this regard I should like to mention the length of time for which the symptoms have been present.

If the patient has had sciatica for several years as the result of a disk lesion, not only must chronic radiculitis be present, but probably changes have occurred in the spinal cord itself to say nothing of the mental pain pattern; in such cases relief cannot be guaranteed. Many patients are relieved by manipulation, which is perfectly safe to employ when it is carried out with due regard to the damage that can be done, while leg traction is beneficial to others and the flexion jacket to those who are relieved of their pain by opening up of the posterior part of the intervertebral space. At times the symptoms recur after relief has been given by these conservative means; some patients ask to have the procedure repeated, and others elect to have a damaged disk removed.

Conclusion.

Let it be remembered that sciatica never killed anybody so far as we can discover in the literature; therefore, our methods of treatment should not endanger life. Also, let it be remembered that there is a psychological element in every pathological condition, and whilst I am on this theme I shall close by giving the following case record:

A married woman, aged fifty-two years, consulted me in May, 1944, complaining of pain in the back and right leg of thirteen years' duration. The pain was confined to the fourth lumbar dermatome, over which there was hypaesthesia in the gluteal region, the thigh, the front of the knee and the antero-medial aspect of the leg. The knee jerk was absent on the right side, and muscle wasting was apparent, in spite of the patient's age, build and sex. The X-ray films revealed considerable diminution of the intervertebral space between the third and fourth lumbar vertebrae. On the history and physical findings a diagnosis of a rupture of the third lumbar intervertebral disk was readily made, and this was fortified by the eliciting of the thumb sign on the right side at the level of the involved disk. The patient was informed that only an operation could hold any hope of giving her relief. She had definite views on that subject, and told me that she had heard so much about the good results of treatment of sciatica by means of manipulation that she was determined to try that particular form of treatment before anything else. Much against my judgement I manipulated her spine. The following day, when I went to see her, I expected to be told that her pain was more severe or that she could not move her legs; to my relief she informed me that she felt no different, except for more freedom of movement in the back. Two days later she said the pain was easier and on the fifth day she returned home, feeling more comfortable than she had for many years. In March, 1945, she wrote to tell me that she had been completely free of pain in the back and the leg ever since she had left the hospital after the manipulation.

Even Shakespeare recognized the psychological aspect of disease and the power of suggestion; this is shown by the following imprecation which he put into the mouth of Timon:

Thou cold sciatica
Cripple our senators, that their limbs may halt
As lamely as their manners!

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SCIATICA.¹

By R. A. MONEY.

Honorary Neurosurgeon to the Royal Prince Alfred Hospital, Sydney.

SCIATICA is not a disease but a symptom-complex, characterized by pain radiating down the course of the sciatic nerve and its terminal branches, usually accompanied by tenderness along the nerve, and resulting in much disability, especially when the patient sits on hard objects or assumes certain postures.

The following classification, though incomplete, has been found satisfactory:

(i) Neuritic	} Peripheral	} Infective	
(ii) Fibrositic			
(iii) Deep ligamentous	} Spinal		
(iv) Arthritic			

(v) Radiculitic: intraspinal, from pressure by: (a) tumours—primary, metastatic; (b) dislocated intervertebral disks; (c) hypertrophied *ligamenta flava*.

The neurosurgical aspects of sciatica are chiefly concerned with the fifth type; but my remarks this evening will be confined to lesions of the intervertebral disks and *ligamenta flava*, which can cause sciatica.

Anatomy.

An intervertebral disk is a pad of fibro-cartilage which binds two adjacent vertebrae together and acts as a shock-absorber. The circumference, a fibrous ring, called the *annulus fibrosus*, encircles a mass of gelatinous, cartilaginous tissue, the *nucleus pulposus*, which is confined between two hyaline cartilaginous plates. The rim of the *annulus fibrosus* is bound in front and behind to the adjacent bodies of two vertebrae by the anterior and posterior longitudinal ligaments. Each nerve root as it emerges from the spinal canal through its intervertebral foramen, is bounded anteriorly by the posterior longitudinal ligament overlying the intervertebral disk and posteriorly by the *ligamentum flavum* connecting adjacent laminae.

Pathology.

After trauma, often of a minor degree, there occur an initial stretching of the *annulus fibrosus* and a softening and loosening of the *nucleus pulposus* within the disk. These changes cause the early recurrent episodes of "lumbago" and "lame backs".

Subsequently, with further trauma, the enclosing *annulus fibrosus* ruptures incompletely, usually on one or other side of the posterior longitudinal ligament, and herniation of the *nucleus pulposus* occurs either in certain postures or permanently, resulting in aching pain in the "hip" and gluteal regions from compression of a posterior primary division of a nerve root against the overlying *ligamentum flavum*. These two conditions have been referred to by Dandy as "concealed discs" (Figure 1A). Later, complete rupture occurs and portion of the *nucleus pulposus* is prolapsed to one side beneath the posterior longitudinal ligament; this causes further compression of the entire nerve root and the complete syndrome of "sciatica" (Figure 1B).

Finally, this prolapsed portion of the *nucleus pulposus* or the entire *nucleus pulposus* may work its way around the lateral border of the posterior longitudinal ligament, and lie free as a loose fragment underneath the affected nerve root between the *dura mater* and the *ligamentum flavum*. Pain in the back disappears, and there follows a clinical picture similar to that produced by a tumour of the *cauda equina* with pain distributed by dermatomes. This loss of disk substance allows collapse between the adjacent vertebral bodies, and the intervertebral foramina become smaller and compress the nerve roots still further. In association with each of these types of lesion, the

¹ Read at a meeting of the New South Wales Branch of the British Medical Association on July 26, 1945.

Ligamentum flavum may be abnormally thickened, and this hypertrophy can produce the same symptoms as abnormality of the disk by compression of the nerve roots from behind.

The types of trauma which may cause lesions of intervertebral disks are the following: (i) lifting of objects when the patient is bending forward or in stooping attitudes; (ii) back strain and "ricks" when the patient is in awkward or twisted positions; (iii) the pushing of heavy objects, such as stalled motor-cars; (iv) stumbling on a curb, stepping down unexpectedly or slipping backwards on a marble step or bath; (v) falls from a height onto the feet or buttocks; (vi) the over-swinging of a golf club and similar sporting activities.

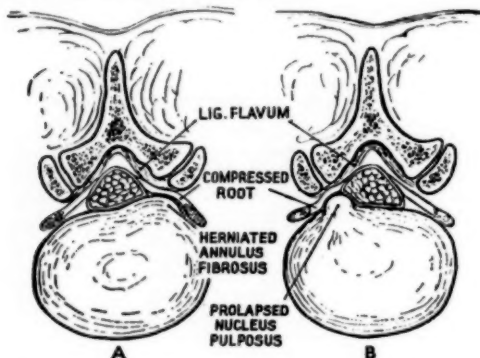


FIG. 1.—Transverse sections through vertebral column showing: (A) herniation of annulus fibrosus and (B) prolapsed nucleus pulposus.

The Clinical Picture.

The first essential step in the recognition of these conditions is the taking of a detailed history and a careful analysis of symptoms.

The Pain.

Although it is usually pain of sciatic distribution which causes the patient to seek medical advice, it has often been preceded for many months or even years by periods of "lumbago" or low back pain. Inquiry will indicate that these attacks have really been in the lumbo-sacral rather than the lumbar regions. This low back pain has usually recurred acutely for varying periods of time at different intervals and has then gradually merged into a pain of unilateral sciatic radiation.

In other cases the sciatic pain has occurred in the initial attack and has been a persistent feature of subsequent attacks, until it has reached a peak and become constant and crippling. Rarely is the pain bilateral; but if this does happen, it is usually much more severe on one side than on the other. The pain is made worse by any exertion, especially that involving forward bending, and coughing, laughing and sneezing cause exacerbations. Commonly the pain awakes the patient from sleep about 4 a.m., at a time when the intracranial pressure normally rises after some hours of rest in a recumbent position. Anything which causes stretching of, or pressure upon, the sciatic nerve or its roots, especially sitting on hard seats, lavatories *et cetera*, is unbearable. Variability and periodicity in incidence and severity of attacks, with alternating intervals of freedom from pain, are also characteristic features.

When the lesion occurs at the commonest site—that is, between the fifth lumbar and first sacral vertebrae, the first sacral root is mainly affected, and the pain is referred to the buttock, the posterior aspect of the thigh and calf, the heel and lateral aspect of the ankle, and the sole of the foot. When the lesion is between the fourth and fifth lumbar vertebrae, the fifth lumbar root is the main root affected, and the pain is distributed along the lateral aspect

of the thigh and leg, the front of the ankle and the dorsum of the foot to the lateral four toes. These two lesions occur in over 90% of all cases of disk protrusion. Should the fourth lumbar root be affected also, the pain is referred to the antero-lateral aspect of the thigh, the patella, the medial side of the leg and foot and the great toe.

Other Subjective Sensations.

Other subjective sensations (paræsthesiæ) are noted in the affected dermatomes and along the distribution of the sciatic nerve. Such sensations are patchy numbness, "pins and needles", tingling *et cetera*, in and around the distal part of the calf and the outer side of the ankle and foot.

"Cramps" occur not infrequently in the muscles of the calf and foot, and in long-standing cases slight weakness of plantar flexion and dorsiflexion of the foot and toes is seen.

Physical Signs.

Skeletal.—In the lumbar region, flattening and obliteration of the normal degree of lordosis are observed, accompanied by slight scoliosis and tilt to the side of the lesion. Movements of the spine are limited in all directions, especially flexion. Tenderness may be elicited when pressure is applied to the spinous processes of the affected vertebrae and to the muscles of the lumbo-sacral area near the sacro-iliac joint on the affected side ("thumb sign").

Neurological.—In almost all cases the sciatic nerve is tender, even in intervals between "attacks". It is this tenderness of the nerve trunk in the buttock and thigh which accounts for the characteristic way in which patients sit in a chair on the sound buttock only and rest in bed on the sound side, with the affected hip and knee flexed. Stretching tests by straight-leg raising (Lasègue's sign) invariably produce pain long before the normal amount of elevation has been attained. Flexion of the neck and dorsiflexion of the foot increase this pain. If the sound limb is raised at the same time as the affected limb, some relief follows and a greater degree of elevation can be attained before pain occurs, but the pain grows much worse when the sound limb is dropped. In very acute cases raising of the sound limb produces pain on the affected side. Impairment of cutaneous sensibility (hypæsthesia and hypalgesia) to light touch and pin prick can usually be demonstrated in the areas of paræsthesia and pain, most commonly along the outer border of the foot and ankle and extending a variable distance up the lateral aspect of the leg. Sometimes some loss of deep sensibility of passive position and passive movement occurs, along with loss of vibratory sensation. The ankle jerk is frequently absent, or at least diminished, on the affected side, but the plantar reflex is always flexor in type, unless complete anæsthesia of the sole of the foot is present, when this reflex is absent too.

Muscular.—The degree of muscular weakness is not great and is not always noticed by the patient. It can often be demonstrated only in movements against resistance, especially in dorsiflexion and plantar flexion of the foot. Some atrophy and wasting may be observed in the muscles of the buttock and leg, and when there is pressure on the anterior division of a nerve root, some fibrillation may be observed in the muscles supplied by it. In advanced cases, in which complete prolapse of the whole nucleus pulposus or a large portion of it has produced the clinical picture of a tumour of the *cauda equina*, all these signs may be increased and bilateral, even to the extent of paraplegia, and disturbances of sphincter control over bladder and rectum may follow, with complete anæsthesia in the "saddle" area. (See Figure II.)

Special Investigations.

Special investigations and tests should be carried out in the following order.

Röntgenological Examination.

Plain skiagrams of the lumbo-sacral part of the spine should always be taken in both antero-posterior and lateral planes, to exclude osseous lesions. In cases of discogenic lesions, obliteration of the lumbar lordosis and some

scoliosis can usually be seen, as well as some diminution of the intervertebral space, if a large amount of the nuclear material has been prolapsed. The prolapsed fragment itself is not as a rule visualized.



FIGURE II.
Showing completely prolapsed portions of the intervertebral disk between the fifth lumbar and first sacral vertebrae.

Spinal Puncture, Queckenstedt and Reversed Queckenstedt Tests.

Spinal puncture should be performed at the third lumbar intervertebral space, and a glass manometer should be attached to the needle. The pressure is usually normal and the fluid clear. Queckenstedt tests are performed to exclude the presence of a block higher up the spine from tumour or some other cause. Before any fluid is withdrawn another needle is inserted through the sacrococcygeal membrane into the *hiatus sacralis*, as for the production of caudal anaesthesia. The reversed Queckenstedt test (as described by Love) is then carried out, by the injection of a solution of local anaesthetic agent, usually a 2% solution of "Novocain", through this needle in amounts of 10 mls at a time. This solution has two effects: (a) it anaesthetizes the sacral and lower lumbar nerves in the extradural space, and (b) it compresses the lower part of the spinal *dura mater*.

If the sciatica is "peripheral" to the exit of the sacral and lower lumbar nerves from the intervertebral and sacral foramina, the pain is first increased slightly and then relieved, so that straight-leg raising can be carried out with comfort. If the sciatica is due to "root" lesions, then each injection increases the pressure upon the affected nerve root or roots by stretching, and reproduces the pain complained of, or causes a considerable exacerbation of it if it is present at the time.

The compression of the sac of *dura mater* by each injection should raise the level of the fluid in the manometer if there is no block between the needles; but if there is some mechanical interference with the transmission of this pressure, either the rise does not occur at all or it is delayed and partial.

Many observers maintain that these tests are unreliable; but on occasions they have been found most valuable in differential diagnosis.

After these observations have been recorded, a few mls of cerebro-spinal fluid are withdrawn for laboratory examination. There is rarely any increase in the number of cells, but, as a rule, when these lesions are present, there is an increase in the protein content to between 40 and 100 milligrammes *per centum* (the normal figure being taken as 20 milligrammes *per centum*). Should the protein content be above 100 milligrammes *per centum*, the presence of a spinal cord tumour should be suspected. However, it must be remembered that absence of an increase in protein content does not exclude a prolapsed *nucleus pulposus*.

Myelography.

In most cases a definite diagnosis as to the nature and site of the lesion can be made from the symptoms, signs

and examinations already discussed; but at times some doubt may still remain, especially in atypical cases and when multiple lesions are suspected. At first, the intrathecal instillation of lipiodol via the *cisterna magna* was freely used for confirmation of the diagnosis and for precise localization, and especially when it was necessary to exclude the presence of a spinal-cord tumour. After the lesion has been located under the fluoroscopic screen, skiagrams are taken in the antero-posterior and transverse lateral planes, and some characteristic pictures may be obtained. However, lipiodol is never absorbed and will remain in the subarachnoid space and infiltrate outwards along the nerve roots, unless it is removed, to cause a greater or less amount of arachnoiditis and radiculitis. Removal can be accomplished only at operation, and thus lipiodol is now used only when operation has been decided upon, to determine the exact level of the lesion or lesions. Moreover, to remove lipiodol, the *dura mater* and arachnoid membranes have to be opened; this increases the risks of the operation, both immediate and remote, and calls for a more extensive laminectomy than would otherwise be necessary. All these factors assume a greatly increased degree of importance when one is dealing with compensation and industrial cases.

The use of air as a contrast medium for the performance of myelography has been advocated and developed especially by Cramp, of the Mayo Clinic. Spinal puncture is performed at the second or third lumbar space, with the patient's buttocks higher than his head, and as the cerebro-spinal fluid from the lumbo-sacral part of the spinal subarachnoid space is withdrawn, air is injected in similar amounts. Skiagrams are then taken with the patient in the Trendelenburg position, and if a fine-focus X-ray tube and a Potter-Bucky diaphragm are used, and the patient is not too obese, diagnostic pictures may be obtained. However, except under ideal conditions, and when the radiologist is skilled, the results of this method of myelography serve only to cloud the issue and cause further confusion, and it is not recommended as a routine measure.

Treatment.

In the short time available, details of treatment cannot be gone into. Obviously every patient suffering from acute "sciatica", though the condition is suspected of being due to a herniated or prolapsed *nucleus pulposus*, should not be submitted to laminectomy, and treatment should be conservative until recurrent attacks of pain, or disabling and persistent pain, indicate that the herniation has become fixed or complete. Even if it is true that most "low back" and sciatic pains are due to varying degrees of lumbar disk herniation, few persons escape some episode of this nature, and in the past the majority of them have recovered without surgical interference.

If the patient is examined at the time of the initial injury to the disk, complete rest in bed in dorsal decubitus for six weeks should be insisted upon to allow the *annulus fibrosus* to heal. But since on these occasions usually only slight pain is felt in the back, the patient rarely visits a doctor, and it is only when the more widespread sciatic pain has begun, indicative of a more complete lesion, that the patient consults a doctor and is willing to go to bed.

Thus most patients are seen in an initial acute attack of sciatica, or because of recurrent attacks, or because of chronic sciatic pain. In these cases special manipulations and traction should be carried out in an endeavour to reduce the herniation and prolapse, followed by a period of absolute rest in bed and fixation in a plaster of Paris cast. Most patients will benefit at least temporarily from these procedures, and some will obtain complete relief. No further treatment will be required unless and until there is a recurrence. However, manipulation is a double-edged sword, and unless carefully and skilfully carried out may lead only to further and complete prolapse, with the production of a florid *cauda equina* syndrome.

If these measures are not successful, then there follow three occasions on which the operation of laminectomy is indicated. They are as follows: (1) when acute sciatica persists despite complete and adequate rest for six weeks; the pain has usually been severe enough to require injec-

tions of morphine, and complete prolapse of portion of the *nucleus pulposus* has almost certainly occurred; (ii) when attacks of sciatica recur at frequent intervals, severely enough to send the patient to bed and make life miserable for three or four weeks every year, despite orthopaedic measures; (iii) when sciatica is chronic and continuous despite adequate conservative treatment.

Owing to the accuracy with which the offending disk or disks can be localized, the laminectomy need not be extensive, and in most cases partial laminectomy or hemilaminectomy with complete removal of the intervening *ligamentum flavum* is quite sufficient. The protrusion can then be removed extradurally by displacing the overlying nerve root medially. Little weakening of the back results, and the patient can be safely and comfortably on his feet in three weeks.

In those cases in which there has occurred a more diffuse herniation of the *annulus fibrosus* without localized prolapse of the *nucleus pulposus*, and with a considerable amount of "low back" pain as well as sciatica, a more extensive laminectomy may be necessary in order to curette out the disk completely from both sides. This is essential in cases of this type if good results are to be obtained. Even so, little disability follows, and fixation or support by bone grafting should rarely be called for. Where the prolapsed or herniated disk has presented in the mid-line, it may be necessary to open the *dura mater* and remove it transdurally. When lipiodol has to be removed, the arachnoid must be opened as well.

Results.

Results cannot be fully discussed in the time available, but when the ultimate results of operation are being considered two factors have to be borne in mind: (i) the chances of recurrent herniation and prolapse at the site of the operation; (ii) the chances of subsequent damage to another disk after operation. The first factor should rarely occur if adequate and complete removal has been carried out at the time of operation, whilst the second factor, though a possibility, can be avoided by taking precautions to prevent fresh trauma and "incidents" likely to be a cause.

LOW BACK PAIN.¹

By A. V. MEEHAN,
Brisbane.

WHETHER pronograde animals suffer from low back pain, they are not in a position to tell us. A study of the comparative anatomy and physiology of the human species would undoubtedly lead us to surmise that *Homo sapiens* commonly suffered from this symptom, even without the added evidence that the confessions of the consulting room provide. When, in association with a study of anatomy and physiology, we consider the habits of this peculiar animal, we can be forgiven for wondering how any specimen of the species escapes this symptom. Amongst these extraordinary habits I shall draw your attention to two only. The human being, from an early stage in his growth and development, is compelled by civilized convention to sit immovably with his back flexed for long hours daily while he sets about acquiring the elements of a modern civilized education. In many cases this habit is continued throughout the duration of life. The second habit to which I refer is that of standing for long periods in a set position, usually with the spine flexed, and again being compelled by convention to maintain this attitude in spite of fatigue or discomfort until the day's work is completed. With regard to anatomical features, certain peculiarities which accompany the orthograde position deserve brief attention. The so-called lumbar lordosis is a feature of man alone amongst the animals. Even the orthograde apes do not possess it. It does not become really obvious in man until the age of two years. It is

accentuated by the presence of a wide and variable lumbo-sacral angle, which in some people reaches almost 90°. This feature is more pronounced in the female of the species. In man there is a modification in musculature in the lumbo-sacral region: the attachments of the *erector spinae* group of muscles are much more extensive than in quadrupeds, and the *quadratus lumborum* constitutes a solid mass of muscle instead of a series of separate fasciculi. In spite of this adaptation of muscle structure to the orthograde position, the strain on joints and ligaments in the lumbo-sacral and sacro-iliac areas is constant and severe, and is a factor which by comparison does not exist in pronograde animals or even in the orthograde apes. The latter animals progress freely by using their upper extremities to swing from branch to branch, and vary this by standing upright. The unenviable human species is condemned to bear the strain of body weight constantly in the lumbo-sacral and sacro-iliac regions, except when he is lying down taking his well-earned rest.

Added to this is another important factor contributing to the development of low back symptoms. Few men take advantage of the modified muscular structure and function with which nature provides them—the muscles are not developed by adequate use. Their development in fact is retarded by the assumption of straining postures as part of the price that man has to pay for the conventions of modern civilized life. The lumbo-sacral region in man is noted for its variations in bone and joint structure. To enumerate only two of these variations, in about 4% of human skeletons the fifth lumbar vertebra is incorporated in the sacrum. The lumbo-sacral joints are often asymmetrical. It seems likely that these abnormalities tend to increase the vulnerability of this region to the action of straining forces. The intervertebral disks in this variable region are also subject to undue strain by comparison with that taken by the disks at other spinal levels. They are stout and strong, but not strong enough to prevent rupture from a strain or series of strains which cannot always be classed as abnormal.

From a consideration of this short summing-up of features of the human lumbo-sacral region, it does not require very subtle thinking to make one marvel that any human being can escape low back pain.

Without obscuring our consideration of this subject with a wealth of detail concerning the differential diagnosis of abnormal conditions involving the lumbar, lumbo-sacral and sacro-iliac regions, I should like to indulge in one generalization. The common denominator of all these conditions—apart from those caused by actual disease or trauma—is faulty body mechanics. As far as the treatment is concerned, a great deal can be done in the way of prophylaxis. In adolescent children faults in posture commonly pass unnoticed until they have developed into gross deformities. Postural faults are camouflaged by clothing, and in many cases the children are away from their parents' observation at boarding schools. Common postural faults are exaggeration of the dorsal curve, often referred to as round shoulders, increased lumbar lordosis or "sway back", and scoliosis. Too often, too, if these deformities happen to be noticed, the only treatment they receive is a daily dose of class gymnastic exercises devised for developing normal subjects and not for correcting disabling postures.

To quote an example, let me draw your attention to the common condition of round shoulders. Routine examination will reveal shortening of the hamstring muscles. This can be readily demonstrated by asking such a child, while lying on a table in the supine position, to perform the movement of straight-leg raising. It will generally be found that the range of this movement is deficient, often to the gross extent of forty-five degrees. If such a patient is asked to stand erect and without bending the knees to attempt to touch the toes with the finger tips, it will be found that the apex of the curve formed by the back during this action is in the mid-dorsal region. The normal uniform convexity of the back which should occur in this movement is replaced by a sharp curve in the dorsal region—a curve which greatly accentuates the deformity of round shoulders. The explanation is, of course, that

¹Part of a symposium on low back pain, held at a meeting of the Queensland Branch of the British Medical Association on August 3, 1945.

with the lower limbs in extension at the knee joints, the shortened hamstrings, which arise from the pelvis and are inserted below the knee joints, cause the pelvis to be fixed at an early stage of the movement. A little flexion movement takes place at this stage in the lumbar part of the spine, and the rest of the movement must perforce be carried out at the deformed area in the dorsal part of the spine. Yet part of the routine of all class exercises in physical culture is the performance of toe-touching with the knees straight. In patients with shortened hamstrings this exercise increases any condition of round shoulders which may be present, or if such a condition is not present, it will go a long way toward producing it.

There is a big field for general practitioners and school medical officers to observe the early stages of these defects and to see that the appropriate treatment is carried out. In modern courses in physical therapy postural exercises are well taught, and excellent work is being carried out by the graduates. Class work is not suitable, as each patient has individual characteristics which must be dealt with. Even in adults postural faults can in many cases be corrected, with considerable benefit to the patient, even to the extent at times of eliminating backache.

Another important element in the prophylaxis of low back pain is selection of occupation. Clinically it is common to see a slender patient with bad posture—perhaps a long weak back, with round shoulders and exaggerated lumbar curve—fighting an unequal battle against chronic back strain in an endeavour to earn his living by doing laborious lifting work. The only treatment necessary in such cases may be a change of occupation, and no other treatment, no matter how elaborate and skillful, will render the patient fit to continue in his present occupation. Meddlesome surgery is a disappointing tragedy in such cases.

Having drawn attention to important predisposing causes of low back pain, I now propose to consider briefly three common causes of this symptom in its established state. These are changes in lumbo-sacral joints, either of the nature of chronic ligamentous strain alone or combined with arthritic changes, similar changes in the sacro-iliac joints, and rupture of a lower lumbar intervertebral disk.

Precise diagnosis is often difficult in these conditions, for various reasons. I shall mention two only. The three conditions often exist together, or two of them may be combined; in long-standing cases a functional element creeps in, and this particularly applies to patients who are receiving compensation and to members of the various war services. I would suggest that delay in accurate diagnosis and treatment, which is apt to happen in compensation or service cases, often leads to a sense of frustration in the patient. Before he has his condition expertly investigated and treated, a period of months often elapses. In the compensation cases a long period of application of assorted liniments with unsupervised rest often occurs. In the exigencies of the services, spells of inadequate treatment occur, alternating with resumption of duty, and the patient is dealt with by an inevitable series of medical officers until he feels that nobody is interested in him; he becomes introspective and develops a "grouch" against the services. These factors sow the seeds of an increasing functional element.

Such features obscure the issue and make precise diagnosis difficult and response to treatment slow or absent. Two outstanding features, when present, act as clinical guides to the presence of a pronounced functional element. One is that during examination movements of the back are carried out deliberately and unwillingly. Each movement at times is even done in cogwheel fashion, as if the patient was testing the effect of every few degrees of movement before he proceeded to the next phase. A second indication is what can conveniently be called the spread of symptoms. A patient will give a history of attacks of low back pain in a precise situation which remained stationary and unassociated with other symptoms for some months. He will then relate how the attack of pain, when it comes, now spreads up the spine even to the head and causes all manner of symptoms, such as palpitation, dyspepsia and faintness. In such cases the prognosis

from any form of treatment is indeed bad, and the patient's lack of cooperation during examination makes an accurate diagnosis difficult to achieve.

However, if a patient with low back pain is taken in hand early, a clear-cut diagnosis of one of the three conditions which we are considering can often be made.

Many signs have been described for the purpose of differentiating sacro-iliac from lumbo-sacral conditions. I do not propose to enumerate these, as they are well described in standard articles on the subject. The two points which I have found of most value are the site of tenderness, when present; this is in the region of the posterior inferior iliac spine in sacro-iliac conditions and in the region of the posterior superior iliac spine in lumbo-sacral conditions. The second point refers to the straight-leg raising or Lasègue's sign. In the supine position, if the leg is passively elevated with the knee joint in the position of full extension, the first 20° of movement, if the test is performed gently and slowly, take place at the hip joint. At this stage the hamstrings are taut, and further elevation of the limb brings about a rotary movement at the sacro-iliac joint. If acute involvement of this joint is present, reflex spasm of the hamstrings will occur, and further elevation of the limb will be resisted. Lumbo-sacral movement commences at a higher level, and resistance due to acute involvement of this joint, in the absence of a sacro-iliac lesion, will not occur until a considerably higher elevation of the limb is reached.

With regard to lesions of the lumbo-sacral intervertebral disk in the stage before actual sciatic nerve irritation occurs, I know of no way of distinguishing symptoms and signs from those of a lumbo-sacral lesion. When this distinction can be made the problem of low back pain will be greatly simplified. At present I regard a diagnosis of ruptured intervertebral disk in this situation without the symptom of sciatica as a shot in the dark. It may well be that when methods of diagnosis become more refined many of the conditions now diagnosed as lumbo-sacral strain will be found to be due to disk lesions in the presciatic stage. Until then, operative search for a disk lesion in the absence of sciatica is, in my opinion, contraindicated.

Treatment.

I would say at the outset that for patients with a well-established functional element, no physical treatment, including operative treatment, is likely to give satisfactory results. When an organic condition is present which can be clearly diagnosed, treatment of this may provide the brilliant exception to this rule; but such exceptions are rare. In functional cases, even when a gross organic condition is present, a well-planned and perfectly performed surgical operation will often leave the patient complaining of most or all of his previous symptoms, and his last condition may be worse than his first. Still, the organic condition will generally have to be treated. The physical treatment should, however, be preceded by a serious attempt to get rid of as much of the functional element as possible.

I would divide methods of treatment of the three organic conditions which we are considering into early or acute and chronic lesions.

In the case of an acute lesion prolonged bed rest should be avoided when possible. Injections of a local anæsthetic agent or careful strapping of the back will, in mild cases, allow a patient to remain ambulant, and actual movement of the back should be encouraged as soon as pain will allow it. Carefully supervised exercises will often complete the cure. If the symptoms are so acute as to demand rest in bed, the bed should be of the non-yielding type, or if this is not available, the patient should have his mattress on the floor. Strapping or injections of local anæsthetic are again useful, but exercises of the back should be commenced in bed as soon as the patient can be persuaded to do them. He should be allowed to walk about as soon as is practicable, and the exercises should be continued till recovery occurs. An early resumption of normal activities should be aimed at, as it constitutes excellent prophylaxis against the development of a functional element.

The surgical treatment of chronic lesions may be divided into the following methods: (a) manipulation under anaesthesia, followed by supervised exercises; (b) postural exercises, if necessary preceded by injection of local anaesthetic; (c) absolute rest in bed, if necessary in a plaster cast; (d) operative treatment; (e) the fitting of a supporting belt and the use of a non-yielding bed, which may be all that is required in mild cases of lumbo-sacral or sacro-iliac strain to give relief from symptoms.

Manipulation.

Manipulation under general anaesthesia is sometimes effective in cases of lumbo-sacral or sacro-iliac strain following ligamentous injury and not associated with radiological changes. The most likely explanation of its success is that scarring of ligaments or periarticular adhesions occur in these cases. Stretching of the scar or adhesions is associated with pain. By manipulation the scar is stretched or the adhesions are broken, and as a result painful stretching is no longer possible. It is essential that manipulation be followed by active movements, and particularly by the repetition of the movement which used to cause pain. In my opinion manipulation is a dangerous procedure in cases of rupture of the intervertebral disk. Fresh extrusions of the *nucleus pulposus* may be caused by it.

Postural Exercises.

When an obvious postural defect is present, postural exercises may constitute sufficient treatment to relieve symptoms. Local anaesthesia, by eliminating pain on movement, may occasionally be necessary at first to allow exercises to be performed.

Rest.

Rest in bed is reserved for cases in which pain is so severe and constant that active exercises are obviously impossible; it is particularly applicable when radiological examination reveals osteoarthritic changes or gross developmental errors. In severe cases a double spica plaster cast should be applied. If severe muscle spasm is present, particularly of unilateral distribution, the cast should be applied under general anaesthesia. This treatment is suitable for lumbo-sacral and sacro-iliac conditions and for those cases of suspected rupture of an intervertebral disk in which neurological changes are not present. A sufficiently long period of rest in a plaster cast will cause disappearance of symptoms in many cases of severe sciatica due to a ruptured disk; in many of them the sciatica will not recur. Except in cases in which neurological changes are present, this method should be given a reasonable trial before operation is undertaken.

Operation.

Operation is indicated in cases of lumbo-sacral or sacro-iliac arthritis in which symptoms are severe and persistent, and in which an adequate period of rest in a plaster cast has not given relief. The only operation likely to be of permanent value is arthrodesis of the joint involved by intraarticular or extraarticular methods. These operations are major procedures and should not be undertaken lightly. They are not without mortality, and provision should be made for treating shock, which may at times be severe. In no case should these operations be performed without a preliminary period of rest in bed for a week or two. This measure greatly reduces the likelihood of shock or of dangerous ileus following operation. For ruptures of the intervertebral disk the extradural exposure in skilled hands is a procedure which does not involve grave risks. In my opinion, however, it should be performed only by surgeons experienced in the technique of neurological surgery. It is not an operation for the occasional neurological surgeon. The fact that even in the hands of skilled neurological diagnosticians spinal tumours have been mistaken for extrusions of the *nucleus pulposus* is a strong argument that this operation should be undertaken only by surgeons sufficiently experienced to be able to change tactics during an operation to meet the unexpected circumstances.

LOW BACKACHE.¹

By ALAN E. LEE,
Brisbane.

WHAT I have to say tonight about low backache represents a general-practitioner approach to the subject, and I claim no specialist orthopaedic knowledge. It is common to hear the statement that the cause of backache is often a mystery. This is partly because of the different explanations that have been offered by different generations of practitioners, only to be discarded (by the better educated) at a later date.

If a practitioner's medical education was to cease with graduation, we should indeed find in the various age groups of the profession the most differing views as to the meaning of low backache. Early in this century backache was regarded as a condition demanding surgical treatment for its relief, and Cuscaden, in an article entitled "Low Backache in Women", maintained that essentially all backache could be relieved by one of three procedures: removal of the coccyx, ventrosuspension of the retroverted uterus, or fixation of the mobile kidney. Later, as the advocates of focal sepsis became active, the colon especially became implicated as the source of the postulated sepsis that caused fibrositis, and elaborate colonic irrigations *et cetera* were added to the well-accepted removal of teeth, tonsils and appendix. Then came the era of the orthopaedist, and great importance was attached to congenital abnormalities of the lumbo-sacral region (which are present in about 25% of people), sacro-iliac strain, and, later, lumbo-sacral strain and general postural defects of the back, such as scoliosis and lordosis. Whether the modern viewpoint, which emphasizes the functional character of most lower backache, is more correct than the explanations of former times is for the future to decide.

When I tell you that the backaches I am called upon to treat fall into four or five groups, I realize that there are other rarer causes beyond those I am discussing. It is desirable that diagnosis should be as exact as possible; but if errors are to be made, it is much better that a rare cause should be missed than that practitioners should fail to recognize and therefore mistreat backache which belongs to one of the common groups.

Ætiology.

When I see a patient whose main presenting symptom is low backache, I expect his condition to be classifiable into one of the following groups.

1. Much the largest group consists of backache suffered because the patient feels tired. Though this is so, it may not be at all obvious at first sight. This group of patients will tell you their backs are comfortable at rest, but after a certain exertion, and sometimes only the mildest exercise, their back aches, to become comfortable again with rest. Now it is important to realize that this type of backache can be physiological. There is no person whose back will not ache if a sufficiently prolonged and intense tiring stimulus is applied to it. How intense the stimulus must be will depend on the normality of the back, on the efficiency of its muscular tone, and on the level of the person's sensory threshold. So the reason for a back's aching after little exertion is that there is a defect in one or more of the three factors listed above—the posture, the muscle tone or the sensory threshold. Adequate investigation will usually reveal that a defect is present in all three factors, but it is especially a lowering of the sensory threshold that is at fault. In the extreme cases, when the patient comes to the doctor, not only is the patient generally tired from the effort of leading his ordinary life, but more or less constant backache is evoked by the mere maintenance of the erect posture. That low backache is still an example of the physiological response to tiring is shown by the facts of its production by exertion and relief by rest. With the passage of time, as the over-awareness of stimuli from the area becomes greater, discomfort may become almost constant, with an additional spread of

¹ Part of a symposium held at a meeting of the Queensland Branch of the British Medical Association on August 3, 1945.

tenderness to adjacent structures, such as the coccyx. I have no doubt that almost all examples of painful coccyx belong to this nervous group, and removal of this structure can hardly ever be a rational method of treatment.

2. As a sub-group of this first type there is frequently encountered an ill-localized backache, of moderate intensity, which seems to be associated with infection, and especially that of the upper part of the respiratory tract. Just as backache is part of the general discomforts of such infections as influenza and dengue fever, so it seems to me common to find that during colds and exacerbations of tonsillitis and sinus infections backache is easily induced. It is a backache that is diminished by rest and the presumption must be that the infection has reduced muscle efficiency and thereby made tiring stimuli more easily appreciated. Though I think we can recognize this relation between backache and attacks of infection, I am far from suggesting that backache of a more chronic type should be treated by operations on the tonsils or infected sinuses—procedures which I think for this reason, as for most others, will be used in the future much less frequently than in the past.

3. A third small group of backache is that in which pain seems to be felt in the back, but is really produced in deep structures. To understand this it is necessary to recall a fundamental axiom in diagnosis—that symptoms of deep origin are not localizable. It is only in relation to surface stimuli that Nature has needed to develop the capacity of accurate localization so as to repel instantly any threat to the body's well-being. When internal pain is produced, whether by irritation of mesenteric nerves or by tension on fascial sheaths, such as those of the pancreas or prostate or the kidney or the pelvic structures, the position of this pain can be recognized only in relation to surface structures. Such pain, then, can be related diffusely to the front or to the back, and clinicians will readily recognize a group of internal ailments in which the pain seems to be in the back. You must note that it only seems to be in the back; it is therefore not affected by back function, and any attempts to attack it there by anaesthetic injections or other local methods are doomed to failure. When renal disease produces backache, we observe an example of this group. Similarly, the intense low backache observed in the premenstrual phase of emotionally unstable women with uterine retroversion is an awareness of tension on fascial supports, rising to consciousness because of the combined effects of a general low pain threshold, lowered still further prior to menstruation. The pattern here is physical, even if the awareness is the result of neurosis.

4. In another group of moderate size, the underlying cause of the backache is disease of the lumbo-sacral joint system. In the commonest type, the underlying pathological condition is chronic hypertrophic arthritis, and in the same way as single joints in the extremities are affected, so these back joints react to movement beyond a certain range, or to overwork, by the production of pain. Some of the pain is produced in the joint itself, and some is due to protective muscle spasm. These are the patients who typically wake up stiff and sore in the mornings, who lose most of their discomfort with moderate activity, but who feel the pain again after much back exertion. Examination reveals a moderate restriction of movement, and X-ray investigation gives evidence of spondylitis, and in these patients, especially if they are run down nervously or physically, an unusual insult to the affected joint may light up a bout of agonizing muscle spasm, with rigidity and locking of the back, and all the other signs of widespread spasm. Sometimes the spasm is not universal throughout a muscle group, but takes the form of acutely tender nodules, which have been shown by electric and other studies to be due to areas of localized muscle spasm. These are the nodules which are still called fibrositic nodules, though they are in the muscle and not in the fascia, and they are always secondary to an underlying abnormality. Injections of local anaesthetic agent into the involved area will often produce a dramatic temporary cure; but because the underlying causal factors are still present, recurrence is almost certain.

5. The fifth type of backache which can be recognized is that associated with a derangement of the joints in the lumbo-sacral area, and especially with injury to the lowest intervertebral disks. It is now generally known that in a large group of cases of severe recurrent sciatica, the explanation lies in a mechanical interference with the lowest lumbar nerve roots due to a protrusion backwards of the *nucleus pulposus* through a break in the *annulus fibrosus* in one of the two lowest intervertebral disks. The history of such patients will reveal not only that the sciatica is associated with low backache, but that such backache often precedes the onset of sciatica by a matter of years.

There must therefore be many patients with such a backache whose future history will prove this backache to be the precursor of a physically induced sciatica. What is the exact underlying mechanism in the production of such backache and how it can be recognized before the onset of sciatica are at present problems exciting great interest. The whole subject is new and still in the formative stage, but there are at least inklings of the truth.

The lumbo-sacral area appears to be one of those regions of the body that has suffered from the adoption of the erect posture. As the lower end of the vertebral column is approached, the lateral intervertebral joints change from their almost vertical type to a transverse shape. While this makes for great suppleness in the rear end of a four-footed animal, the position is different when all the body weight has to be carried through them to the lower limbs, and it makes this portion of the vertebral column distinctly unstable. It is believed that owing to this instability strains and injuries frequently occur in these lateral joints, and these are often followed by compression injuries to the lowest disks.

Whether it is the strained lateral joints that produce the unilateral backache or whether the pain is produced by a ruptured disk less complete than that necessary to angulate a nerve root and produce sciatica, or whether the pain is merely neuralgia in the posterior branch of the affected nerve is at present uncertain. Certain it is, however, that adequate surgical treatment to the affected disks can cure the backache. Clinically it is typical of these disk backaches that they recur in well-defined attacks. Between attacks the back may feel quite normal or may always possess a certain instability, so that the patient feels that an unguarded movement may precipitate a sudden incapacitating attack. Much of the pain in such attacks, which may last from days to months, is due to secondary muscle spasm, and is accompanied by the limitation of function of such spasm, and any treatment which relieves spasm—be it rest, the application of heat or the injection of local anaesthetic agents—is likely to cause some temporary improvement or to end an attack. But the feeling of insecurity remains, attacks continue, and ultimately the development of an associated sciatica gives sufficient certainty to the diagnosis to make exploration justifiable. Dramatic cure follows the appropriate surgical attention to the affected intervertebral disk.

These, then, represent what in my experience are the five common explanations of low backache: (i) functional aetiology due to the over-awareness of tiring stimuli, because of defects in the dynamics of the back, poor muscular tone and especially a low sensory threshold; (ii) infection; (iii) the projection of a deeply produced pain to the surface of the back; (iv) chronic vertebral arthritis; (v) injury to the lowest intervertebral disks and the lateral joints. You may say that I have left out many other causes, such as spinal cord tumours, secondary metastatic growths *et cetera*. I know I have done so; but these are relatively rare, and therefore not to be considered primarily in a differential diagnosis. It would take a great deal of argument to convince me that it is not better to miss the rarity by ascribing its symptoms to a common cause than to mistreat over many months one of the common causes of backache, by erroneously labelling it amongst the rarities. While we should strive for exact diagnosis, it is better to miss a rarity than to fail to understand a common explanation.

Discussion.

Now let me say a few words as to how these various classes of backache are to be treated. In these matters my viewpoint is that of the general practitioner, and what I think about treatment may not receive the approval of some of the orthopedic specialists.

More than any other part of the body, the back depends for its efficient functioning on good posture and good muscle tone, both dynamic activities to be attained and maintained by properly regulated function, and any treatment that neglects these functions seems to me *a priori* bad. I cannot think that there can be other than an exceptional case in which prolonged bed rest is not bad treatment for a back condition. Even if we take extreme examples in which local rest is desirable, such as a fractured vertebra or a tuberculous focus, it must surely be a correct general principle that this local rest should be obtained in some way that does not destroy these factors of posture and muscle tone. That even in such cases this is possible was one of the salutary lessons taught in Böhrer's clinic in Vienna. With regard to the common explanations of backache with which I am dealing, I believe that if rest measured in days will not relieve it, rest measured in months will do no better.

Speaking specifically of the five groups I have defined, I believe that treatment of the functional group is relatively easy. Once the patient realizes that he has at last found a doctor who understands his case, the battle is nearly won. The raising of the sensory threshold is the chief requirement, and is to be attained by reassurance, the relief of anxiety, full explanation and the exhibition of nerve sedatives of the phenobarbital and bromide classes. Improvement of muscle tone can be rapidly developed by a few minutes of regular gymnastic exercises, while the development of posture is nowhere better explained than in a little book, "Exercise Without Exercises", which shows the patient that back posture needs the constant voluntary practice of the injunctions "sit tall—stand tall—and walk tall" till this voluntary effort becomes an unconscious and automatic activity.

The treatment of that second group of backache due to the projection of pain from internal diseases to the surface of the back need not detain us at all. Find and cure the causative ailment, and the backache will disappear.

Of the pain due to chronic arthritis, it may be said that treatment usually consists of (i) lessening their work, (ii) maintaining their range of movement, (iii) analgesics. In the case of the back, this resolves itself into the provision of rest periods during the day and of firm support to the back with corsets—both to be secured with the least necessary diminution of general activity—and the maintenance of the full range of joint movements by a short daily spell of efficient back exercises. Since it is after a period of rest that this pain is worst, a good practice is for these people to keep an analgesic beside their bed and to take it first thing in the morning after waking. In this way they are enabled to resume their activities with less discomfort than would otherwise be the case. Since it appears to be an improvement in the blood supply to the affected joints that eases their pain, a hot bath followed by exercises is also a good beginning to the day's activities. Remember also that, as in the case of all chronic pain, a local sensitizing mechanism comes into play; thus measures which raise the general nervous threshold are always helpful.

In the group of backache associated with disk or joint injuries the treatment of the attacks of muscle spasm may be separated from that of the underlying cause. Spasm may be relieved by a short period of bed rest, by the application of heat, and by local anæsthetic injections into the affected muscles or the tender muscle spots. I believe the actual underlying cause demands a special attack. Whether this is to be limited to removal of the protruded *nucleus pulposus* or whether in addition, as Dandy insists, the disk must be thoroughly curetted away so that a broad bony union is produced between the adjacent vertebrae remains for the future to decide. My own experience would suggest that this latter manœuvre is not essential for the long-

continued relief of symptoms. An experience now extending to about 40 operations would also suggest that, even in the absence of a definite nuclear protrusion, something is done in a careful hemilaminectomy that results in the almost immediate relief of both sciatica and backache. Whether this result is obtained by the freeing and decompression of the nerve roots or by a secondary effect on the lateral intervertebral joint is also for the future to decide. Certain it is, however, that the result of surgical treatment in these attacks of severe recurrent backache is such that the patient's only regret is that it was so long delayed.

LOW BACKACHE.¹

By ELLIS MURPHY,
Brisbane.

As my contribution to this symposium on low back pain, I should like to bring to your notice the recent work of Copeman and Ackerman, which appears to throw some light on the obscure ætiology of "fibrositis" and perhaps to explain its occurrence on a pathological basis. Copeman and Ackerman were working as army medical officers in a remote area, when their interest in the problem was stimulated by the great number of young soldiers, who were otherwise healthy, applying for treatment for backache.

Lumbago, sciatica, fibrositis or backache is, as most people know from personal experience, a very real thing, and in view of this fact it is surprising that so little is known of its ætiology. Kelgren drew attention to the presence of "tender spots", and he and others have shown that radiation of pain from such "spots" can cause referred pain in remote areas in the distribution of the same dermatome. Some forms of sciatica appear to be due to referred pain of this sort. These "painful spots" in the back occupy restricted areas, and are themselves localized. Pressure directly on the spot may produce intense pain, which is lacking on pressure a few millimetres away. If referred pain is present, it again may be elicited by pressure on the appropriate "spot". The tender spot is always a firm small mass palpable in the subcutaneous tissues, and has been variously described as "trigger point", "rheumatic nodule", "fibrositic node", "myalgic spot", and so on. Injection therapy has been successful in many such cases; but it is necessary that the injection be accurately made into the centre of the node. Such treatment is not new, having been practised as acupuncture for centuries, and amongst the natives in Central Africa it is still a favourite method of treating painful areas.

The above-mentioned workers noted the occurrence of similar painful spots in men who had recently recovered from some acute indisposition, such as the exanthemata, influenza, malaria, dysentery and infective hepatitis. Frequently the patients themselves were unaware of their presence. These tender spots were noticed to occur in a definite pattern, and their position in the lumbar and gluteal regions was often predictable.

Close observation showed certain differences between the sites of pain in the dorsal region and sites of pain in the lumbar and gluteal regions. The dorsal pain came on more slowly; the tender spot was along a line parallel with the spine, but some two inches from it. The pain seemed to be associated with the movement of certain muscle groups, and crepitus could sometimes be felt. There was no referred pain, and the muscle tendon which was painful could be rolled under the fingers. This led to the

¹ Part of a symposium on low backache, held at a meeting of the Queensland Branch of the British Medical Association on August 3, 1945.

supposition that the pain in such cases was due to tenosynovitis of the long tendons of the dorsal muscles.

Copeman and Ackerman made a chart showing the position of the tender spots in 50 subjects suffering from backache. In the dorsal region the most common site of pain was in the region of the tendon of the suprascapular muscle as it passed deep to the acromial process of the scapula. Pain was noted along the vertebral borders of the scapulae, in the small area near the angle of the scapula where the *latissimus dorsi* crosses over the last rib. Pain between the shoulders appeared to be along the lateral borders of the spinal muscles. In the lumbar region the most common site of a painful spot was along a line just above the iliac crest, one inch above this level, or at the level where the *latissimus dorsi* muscle crosses the outer edge of the sacrospinalis. In the gluteal region the tender spots were along the iliac crests or some two inches below them, and also along the posterior aspects of the sacro-iliac joints.

Having made this chart of the common sites of painful spots, Copeman and Ackerman carefully dissected 14 bodies, many of them in an advanced state of malnutrition. They paid particular attention to the areas shown in their charts. Their observations were as follows: (i) no fibrous lesions, abnormalities, or adhesions were found at a deeper level than the subcutaneous tissues; (ii) a basic fat pattern persisted even in the most cachectic bodies, and this roughly coincided with the pattern of painful spots.

They also observed that ordinarily there was only a potential space between the highly vascular superficial fascia and the deep fascia, except in special regions, where masses of pinkish fat were persistently found.

This peculiar pinkish fat was found along the tendon of the supraspinatus muscle, inside the investing fascia of the trapezius muscle outlining its borders, along the vertebral borders of the scapulae, and also inside the synovial sheaths of the tendinous portions of the sacrospinalis muscles. It was thought that oedema of the fat, which was of a fibrous nature, caused pressure within the tendon sheath of the affected muscles. In this way pain was caused which was not actually due to any pathological change in the tendon proper.

In the case of pain in the lower part of the back, the sites coincided exactly with the piercing of the fascia by the posterior rami of the first three lumbar nerves, the nerve taking with it a small blood vessel and in most cases some lobules of fat.

From the foregoing observations, Copeman and Ackerman considered that fibrositic pain bore a close relationship to the basic fat pattern. Herniations of fat lobules were frequently seen during dissection, and later such fat herniae were observed at operation in cases in which pain was present, coinciding with the painful nodes.

The fat herniations could be divided into two types, non-pedunculated herniae and pedunculated herniae. Non-pedunculated herniae were again of two types: (i) masses of fat under a fibrous fascial covering—for instance, in the angle where a fibrous layer splits to embrace the muscle (sacrospinalis); (ii) herniae along the crest of the ilium, where the underlying fat is always under tension from any muscular action, and the fat will tend to herniate through any weak spot in deep fascia; this may take place from a lower to a higher layer, or laterally through fibrous septa. In the case of pedunculated herniae, sometimes masses of fat were found connected to a peduncle resembling a papilloma; in such cases it was easy to see how interference with blood supply could cause tension and lead to pain, with the production of a painful spot.

In this way many cases of backache can be explained as due to a state of tension produced in certain fat lobules in special areas, this in most part resulting from interference with blood supply and lymphatic drainage caused by herniation. Relief of this tension is the obvious treatment, and may be achieved by "needling" of the painful node under local anaesthesia, or by the incision and removal of the swollen fat lobule.

RECENT ADVANCES IN THE DIAGNOSIS AND TREATMENT OF LUMBAR INTERVERTEBRAL DISK DISEASE.¹

By JAMES H. YOUNG, M.D. (Adelaide), M.R.A.C.P.,

Acting Honorary Physician to Out-Patients,
Perth Hospital; Honorary Physician
to Out-Patients, The Children's
Hospital, Perth.

A YEAR has gone by since I spoke about intervertebral disk disease, and I feel that I should apologize for another paper after such a short interval; yet the year has been one of such interest to me that I hope you will perhaps tolerate some more about this type of work.

In the past year many advances have been made. It is now certain that lesions of the disk are very common. Diagnostic methods have been greatly simplified, the existence of disk disease causing low-back pain without root pain has been proved at operation, rational methods of treatment have been adopted, and operative technique is being improved.

Apart from disk disease, there are few proved pathological conditions in the back itself which cause low-back pain and they are mostly diagnosed radiographically—for example, spondylolisthesis, fractures, Paget's disease, tuberculosis and carcinoma. In my experience such conditions account for a minority of cases only.

Diagnoses such as torn muscles, lumbo-sacral and sacro-iliac strain, adhesions, fibrositis, sciatic neuritis and radiculitis have never been subjected to the final test of demonstration of the lesion at operation or autopsy, and most of these terms will probably disappear from our diagnostic vocabulary. Spondylitis is a name that should now be reserved for the ankylosing variety first described by Strümpell and Marie. Disk disease is the only proved pathological entity which commonly causes low back pain.

The intervertebral disk is responsible for about 95% of cases of sciatica.⁽¹⁾⁽²⁾ In my practice I think it is responsible for 90% of cases of low-back pain. I make this statement because the symptoms and signs in the majority of patients suffering from low-back pain are identical with the symptoms and signs in those patients in whom a disk lesion has been found at operation. I find it impossible to give an exact estimate of the frequency of occurrence of disk disease, as I do not see many patients with backache of visceral or metabolic origin, and I do see many with persistent and severe backache which is nearly all diskogenic.

It is important to recognize the great frequency of disk disease, not because one is making an ingenious diagnosis and subjecting the patient to spectacular surgical treatment, but because, if one recognizes the early stages of disk disease, one will adopt treatment which will, I hope, render these spectacular surgical measures much less frequently necessary than at present. The recognition of the frequency of disk disease thus becomes a matter of prophylactic importance.

Now, why is disk disease so frequent? First, it has been shown by investigators at the Mayo Clinic⁽³⁾ that the blood vessels of the disk generally disappear during the third decade. This makes reparative processes more difficult and predisposes the disk to degeneration. Second, we were not intended to live and work in a civilized world lifting heavy weights, and this throws a strain on the posterior part of the intervertebral disk.⁽⁴⁾ Third, the posterior part of the disk is supported only by a weak ligament. Fourth, the upright position places a strain on the lower lumbar disks. Man is actually in the process of evolving from a quadruped with six lumbar vertebrae to a biped with four lumbar vertebrae. This process is well seen in a series of X ray films showing six lumbar vertebrae, unilateral lumbarization of the first sacral vertebra (it would be more correct to refer to this as sacralization of a sixth

¹ Read at a meeting of the Western Australian Branch of the British Medical Association on October 17, 1945.

lumbar vertebra), five lumbar vertebrae, unilateral sacralization of the fifth lumbar vertebra, and finally, four lumbar vertebrae.¹ Unfortunately you and I are living in the transitional period of this evolutionary process, and it will be some thousands or millions of years before man has a satisfactory back; perhaps by then man's ingenuity will have devised some new stresses and strains for which even four lumbar vertebrae will prove to be inadequate.

The examination of these patients is now a simple matter, free from all complicated and meaningless tests. The method of examination which you will soon see on the screen is divided into two parts—orthopaedic and neurological. If you carry out a careful orthopaedic examination and omit the neurological examination you will make few mistakes. Inspect the patient carefully; test flexion, extension and lateral flexion with the patient in the standing position, and flexion also with the patient in the sitting position; palpate the back carefully in the manner shown in the film; and you should then be able to diagnose disk disease and the type of disk disease, and you should be able to localize the affected disk or disks. The neurological examination requires considerable experience in order to obtain reliable results, and I do not think a general practitioner would be doing his patient a disservice if he felt disposed to neglect it. It is included in the film for those who are interested.²

The lumbar intervertebral disks are the site of three common pathological lesions—rupture, degeneration and herniation. These three conditions merge into one another to some extent. Thus rupture predisposes to degeneration and herniation; a degenerated disk is more liable to rupture than a normal one and it may herniate; and a herniated disk may degenerate.

I have previously expressed the opinion that the usual lesion in low-back strain is a tear in the posterior part of the disk,³ and further experience endorses this view. I am now also of the opinion that the symptoms, signs and prognosis depend upon whether the tear involves the whole thickness of the annulus or not.

Minor Low-Back Strains.

First let us consider those cases in which I believe that there is a tear in the posterior common ligament or in the posterior part of the disk, but in which the whole thickness of the annulus is not involved—that is, incomplete rupture of the disk is present (Figure I, A).

Anything which stretches the tear produces pain. These patients therefore complain of pain on standing flexion, of pain on sitting flexion, and if the tear is situated to one side of the mid-line, of pain on flexion to the sound side. The patient complains of pain on sitting, which flexes the lumbar part of the spine. Extension and flexion to the affected side are painless, because the intact part of the annulus prevents compression of the torn part. There is tenderness on pressure over the affected intervertebral space or just to one side of it. In order to elicit this tenderness it is necessary to place a pillow under the abdomen to open up the spaces between the spinous processes and to relax muscular spasm. Firm pressure is then applied over each space in order to localize the tender disk. Usually the tenderness is over one of the lower spaces, occasionally over one of the upper spaces.

Now, the posterior part of the disk is the only part which is in contact with the blood vessels of the vertebral body, as the cartilage plate covering the vertebra is defective in its posterior part⁴ (Figure I). Tears of the attachment of the posterior part of the disk, if not too extensive, will therefore heal if given the opportunity to do so; but we must be careful to avoid anything which will increase the extent of the tear and thus possibly lead to involvement of the whole thickness of the annulus.

The treatment of an incomplete rupture of the disk is simple—relief of pain, adequate rest in a lordotic position from the beginning, adequate support when activity is resumed, and the avoidance of anything which may

increase the damage. It is important to relieve pain, and for this purpose I prescribe aspirin (10 grains), phenacetin (five grains) and codeine phosphate (0.25 grain) every four hours. The injection of a local anæsthetic agent into a tender sacrospinalis muscle will also relieve pain, but it relieves a protective muscular spasm and allows the patient to do more than he should, thus predisposing him to further damage. I have, for example, seen a disk herniate within an hour of injection of this muscle, and I consider this treatment absolutely contraindicated in recent low-back strain. At the best injection of the sacrospinalis relieves pain for a few hours, and this pain can be relieved more efficiently by rest in the correct position. At the worst it predisposes the subject to further damage. We treat a sprained ankle efficiently with a judicious combination of rest and support. If we treat a strained back in the

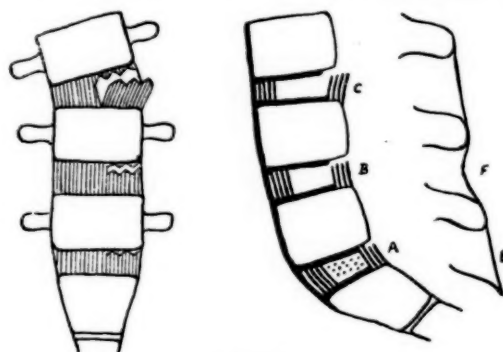


FIGURE I.

Diagrammatic representation of probable stages in the rupture of an intervertebral disk. A: A small tear in the posterior common ligament or in the attachment of the upper part of the posterior portion of the annulus. The whole thickness of the annulus is not involved. The nucleus pulposus, represented by dots in the lateral view, is intact. B: A tear involving the whole thickness of the annulus. The nucleus pulposus is not represented in the lateral view—it has escaped into the extradural space and been absorbed. Following this type of injury the annulus degenerates. C: More extensive detachment of the annulus allows it to project backwards—that is, herniate. In the posterior view the upper vertebra is shown flexed to the opposite side to relieve pressure on the herniated piece of annulus. In the lateral view the upper vertebra is shown flexed forward for the same reason. D: If a pillow is placed under the abdomen to flex the spine, the interspinous ligament is normally palpable as a firm ridge. E: When the annulus degenerates, either after injury or primarily, the two vertebrae tend to approximate, especially posteriorly, because the anterior part of the annulus is unaffected or is affected later than the posterior part. A small approximation of the posterior parts of the vertebral bodies causes much greater approximation of the spinous processes. The interspinous ligament may then be slackened and may be palpable as a depression. The thick lines in the lateral view represent the anterior common ligament and the cartilage plates covering the adjacent surfaces of the vertebrae. The posterior part of the annulus is not supported by a thick ligament, as is the anterior part. The cartilage plates are defective in their posterior parts. Here only is the annulus in contact with the blood vessels of the vertebral bodies.

same way, we shall generally obtain a satisfactory result. We treat a sprained external ligament of an ankle by strapping it in eversion in order to keep the torn ends of the ligament in apposition. We cannot hold the lumbar part of the spine in any position by strapping, but we can rest the patient in a lordotic position, which relieves any strain on the posterior part of the disk. To tell the patient to rest is not sufficient—he will either sit in front of the fire with his back well flexed or he will confine himself to his double bed and sagging mattress. Neither of these things provides physiological rest to the lumbar part of the spine. Fracture boards and a small pillow under the lumbar part of the spine are necessary. In practice I often tell the patient to take his mattress off the bed and put it on the floor, and to keep a hot-water bag under the lumbar part of the spine. The latter maintains the lordotic position and applies heat, which relieves pain, improves the circulation and therefore helps reparative processes. Short-wave therapy also relieves pain and improves the circulation, but

¹ Lantern slides of these X-ray films were shown.

² A cinematograph film of the method of examination of normal and abnormal subjects was shown.

It must be brought to the bedside. If the patient has to leave his bed and go to your surgery or to the physical therapist's rooms for short-wave therapy, then any good the latter might do is far outdone by the harm of letting the patient move about. When the patient is rested in the manner described, pain will usually disappear within forty-eight hours; but as it takes six weeks for a scar to become organized and three months for it to become solid, rest should be continued for three weeks even in apparently trivial cases, and when the patient is allowed out of bed a support should be fitted. The type of support which is used will depend upon which disk is affected. In the majority of cases the fourth or fifth disk is involved, and for women an ordinary surgical corset will be satisfactory. A good type of support has recently been designed by Dr. Leigh Cook (Figure II). When the mid-lumbar disks are affected, a half Taylor brace is necessary, and when the lower thoracic or upper lumbar disks are involved, the only support of any use is a full Taylor brace. An adequate

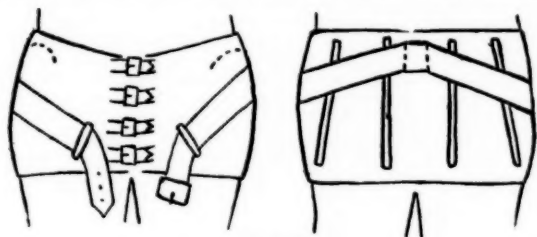


FIGURE II.

Support for low lumbar lesions designed by Dr. H. L. Cook. The reinforcing strap is undone. Of the four small straps the lowest is done up most tightly, the upper straps each being slightly looser than the next lower. Perineal straps are not shown. The iliac crests are indicated by dotted lines.

support costing five pounds or ten pounds does more good than ten pounds' worth of physical therapy and one hundred pounds' worth of liniment. The support should be worn, and the patient should avoid bending and lifting until the scar is solid—that is, for the first three months after the accident. There will be some occasions when the patient must pick up something off the floor. He should therefore be instructed to do this by flexing his hips and knees and not by flexing his hips and spine. Manipulation is another thing which must be avoided in these cases. There is no logical reason for supposing that it will do any good. On the contrary, there is clinical evidence that it often does harm. The patients often complain of increased pain afterwards, and I have several times seen a disk herniate shortly after manipulation. The prognosis of these minor low-back strains is good, provided that efficient treatment is instituted at once. The most common causes of prolonged disability are failure to treat the condition correctly on the first day, too early return to work, and return to unsuitable work. During convalescence light employment should be provided, for then the worker will not be compelled by financial necessity to return to an unsuitable job, thus risking further damage to his back. Until insurance companies and employers realize this, the injured back will continue to cost them much more than it should. At present the injured back is a burden on the insurance company, and through it on industry and thus on the community. It is a much greater burden on the injured worker and his family. The injured back could perhaps even be made an asset to all parties concerned by the provision of a suitable rehabilitation scheme.

Major Low-Back Strains.

In the more severe low-back strains I believe that the whole thickness of the annulus is involved—that is, complete rupture of the disk occurs (Figure I, B). Such ruptures have been demonstrated at operation, and the frequency with which they occur is obvious when one analyses a large number of case histories.

The *nucleus pulposus* disappears—presumably it escapes into the extradural space and is absorbed. Like a tennis

ball which has been deflated, the disk loses its elasticity and becomes abnormally mobile. This abnormal mobility you will see later on the screen when Dr. Clark is discussing operative technique. We have seen gross abnormal mobility six days after injury. Any movement which involves the lumbar part of the spine now occurs first and most at the affected disk (Figures III and IV). This is well seen at operation if the patient coughs or strains.

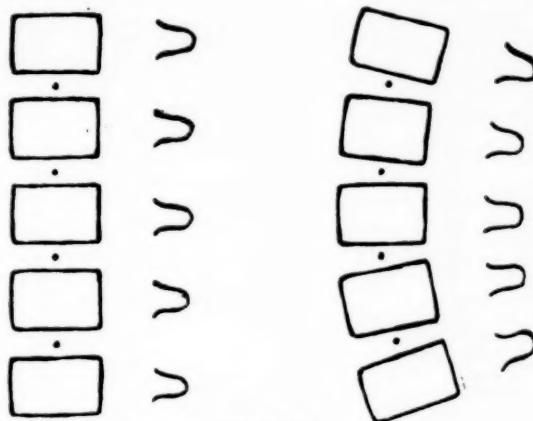


FIGURE III.

Diagram of flexion and extension in the normal spine based upon radiographs taken in a normal subject. The pivot around which movement occurs is at the centre of each disk (shown by the dots). Slight movement occurs at each disk.

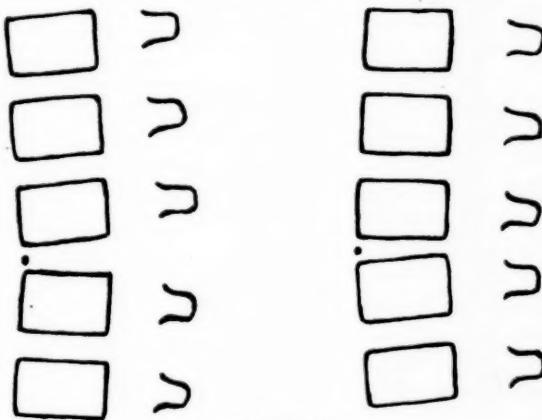


FIGURE IV.

Diagram of flexion and extension in a spine with a degenerated disk based upon radiographs taken in a case of this condition. The degenerated disk is excessively mobile. Movement takes place at the affected disk before it occurs at any others. The pivot at which movement occurs is in the anterior part of the annulus (shown by the dot).

All movements are usually painful. It is noteworthy that extension is painful—presumably because of compression of the posterior part of the annulus. This is an important point in differentiating the major from the minor low-back strains. If extension is painful, the disability will almost certainly be prolonged. Tenderness is present over the affected intervertebral space or spaces, or just to one side of the space.

Rest in bed is necessary. The lordotic position can usually not be tolerated, as extension is painful. A slightly flexed or straight position is most comfortable. Traction is a valuable therapeutic measure. I apply traction with canvas gaiters, or with restraining straps made of soft leather and well padded. Care must be taken

to see that they do not cause pressure sores. This method of extension is much more comfortable and convenient than adhesive strapping. There is no irritation of the skin, and the patient can go to the bath and lavatory when his condition warrants such latitude. Weights are attached to the gaiters or straps by cords which pass over pulleys fixed at the bed rail. The pulleys must not be more than nine or twelve inches apart. If they are too far apart, the thighs will be abducted and the weights less effective. A six or eight pound weight on each leg is usually sufficient.

After the acute stage has passed the annulus gradually degenerates—presumably because of attrition. The symptoms, signs, prognosis and treatment are then identical with those in which degeneration of a disk arises without any known antecedent trauma, and they will be described under that heading.

Degeneration of a Lumbar Intervertebral Disk.

As has already been indicated, degeneration of a lumbar intervertebral disk will follow trauma if the whole thickness of the annulus is involved, and it may arise without any history of injury.

The essential pathological features are disappearance of the *nucleus pulposus* and thinning of the annulus. Even in non-traumatic cases, careful search at operation will usually demonstrate a hole in the posterior part of the annulus. The cartilage plates covering the adjacent surfaces of the vertebrae remain intact and prevent blood vessels from bridging the gap between the vertebrae and so producing ankylosis. Nature, however, will effect a cure in these cases by shortening the surrounding ligaments (here is one explanation of the thickened *ligamentum subflavum*) and thus stabilizing the joint; but this process may take months or years. The prognosis of this condition, and of course of the major low-back strains, is therefore serious.

The essential physiological feature of these cases is the abnormal mobility between the affected vertebrae. Any movement affecting the lumbar part of the spine occurs first and most at the affected disk (Figures III and IV). At operation we have even seen movement occurring between the affected vertebrae with each respiration. All movements may be painful. Lateral flexion may cause pain on the side towards which the patient flexes (compression of the annulus on that side) or on the opposite side (stretching of that side of the annulus). These patients complain of pain on sitting—that is, on flexion of the lumbar part of the spine. Many of them also complain of pain on attempting to straighten up after sitting and of difficulty in doing so; but once they are erect the pain is relieved. I have no doubt that this is due to a slight bulging of the annulus in the sitting position, and that the pain and difficulty in straightening up are associated with gradual reduction of this bulge.

On palpation tenderness is present over the affected intervertebral space or spaces. This tenderness is partly due to hyperaesthesia of the interspinous ligament and partly due to the fact that firm pressure produces movement between the affected vertebrae. When a disk degenerates the two vertebrae tend to approximate, and they approximate more particularly in their posterior parts. Thus the spinous processes come to lie closer together and the interspinous ligament may be slackened. Instead of feeling like a firm ridge (Figure I, E), the interspinous ligament over the affected disk may then be palpable as a depression (Figure I, F). Degeneration of a lower lumbar disk is sometimes accompanied by pain in the lower part of the abdomen or the groin. In these cases, if the patient has a lax abdominal wall, one can palpate a tender spot on the anterior aspect of the affected disk.

In treating a degenerated disk you must remember that you are treating a flail joint, and that recovery will occur only when the surrounding ligaments have become shortened and immobilized the joint. Extension exercises will improve the tone of the sacrospinales, and good tone in these muscles will help to hold the flail joint rigid. Flexion exercises, on the contrary, will aggravate the condition. A firm mattress will prevent too much flexion of the lumbar part of the spine during the night. The wire may have to be tightened in addition. High heels

slightly increase the normal degree of lumbar lordosis. The wearing of shoes with lower heels will therefore sometimes relieve the backache, especially in cases in which there is more pain on extension than on flexion. A support will prevent movement and encourage shortening of the ligaments. Bending, lifting and manipulation merely add fuel to the fire. The place of massage in the treatment of low-back pain is difficult to assess. Heavy massage over the affected disk always makes the patient worse. Heat, massage and the injection of local anaesthetic agents are sometimes of value when there are accompanying areas of muscular spasm ("fibrositis") in the glutei. Local anaesthetics should not be injected into the sacrospinalis for reasons already stated. If conservative treatment fails, the affected disk or disks can be removed for the production of ankylosis between the affected vertebrae.

Herniation of a Lumbar Intervertebral Disk.

If an annulus is loosened or separated from its attachments, it may protrude (Figure I, C). This condition may occur in either the presence or absence of a history of trauma, and it may be preceded by degeneration of the disk for a variable length of time.

Part of the annulus protrudes backwards, and any movement which squeezes this part is painful. Extension and lateral flexion towards the affected side will therefore be painful. The patient thus adopts the opposite posture—that is, forward flexion and lateral flexion towards the sound side, in which position a minimum amount of pressure is exerted on the herniation. The diagnosis of a herniated disk is therefore made on the presence of a deformity of the spine associated with pain on attempting to correct that deformity. A herniated disk can frequently be diagnosed and even localized with some degree of accuracy as the patient walks into the consulting room. There are two types of deformity. The forward flexion deformity is the less common and is associated with pain on extension. It occurs more particularly in herniation of an upper lumbar disk. The lateral flexion deformity, often combined with some forward flexion, is much more common. It is associated with pain on flexion towards the convex (affected) side, but not on flexion towards the concave (sound) side. It occurs especially in the presence of herniations of the lower lumbar disks. Extension is painful in these cases, because it squeezes the protruded part of the disk. Flexion in the standing position is painful, because either the spinal *dura mater* or a nerve root is stretched over the herniation. Flexion in the sitting position, however, is painless or much less painful because the tension on the sciatic nerves and therefore on the nerve roots and spinal *dura mater* is lessened. These patients, therefore, find that sitting relieves their pain, while standing (which extends the lumbar part of the spine) aggravates it. Tenderness is present over the affected space.

These herniations sometimes reduce themselves, and if they do the treatment is then that of a degenerated disk. Reduction may be brought about by rest and traction; but if such treatment does not relieve the patient in ten or fourteen days, removal of the disk offers much quicker relief and much less likelihood of future disability than does further conservative treatment.

Spondylolisthesis.

Spondylolisthesis is now regarded as a disk lesion occurring in a subject with either (a) a congenital defect of the laminae or (b) interlaminar joints lying in the sagittal plane, or (c) interlaminar joints lying in the same plane as the disk. Any of these three conditions predisposes to forward displacement of the upper vertebra on the lower, but such displacement will not occur unless the disk is defective. Spondylolisthesis may coexist with other disk lesions at other levels.

Involvement of a Nerve Root.

You will have noticed that I have not discussed nerve root involvement. I have omitted to do so deliberately; firstly, because all types of disk disease commonly occur without nerve root involvement; secondly, because the diagnosis of disk disease and the localization of the affected

disk or disks are just as easy in the absence of nerve root involvement as in the presence of such involvement; and thirdly, because it is not necessary to know the neurological aspects of disk disease unless surgical treatment is contemplated.

A nerve root may be involved in any of the pathological conditions I have described, and if so the following symptoms may be present: (i) pain in the distribution of the nerve root, not necessarily in the whole root area, but perhaps only in part of it; (ii) sensory phenomena—tingling, numbness, diminution of pain sense, and less often diminution of touch sense—usually in the lower part of the root area; (iii) muscular weakness, tremors, fibrillation and cramps; (iv) diminution or loss of reflexes. These phenomena occur singly or in any combination. It is amazing how often you will find evidence of root involvement if you ask and look for it. Frequently the patient will not mention a slight pain or tingling in the leg—the pain in the back is much more acute. The radicular syndromes have been described previously.⁽²⁾

If a degenerated disk is accompanied by a root pain, epidural injection followed by traction precedes the usual treatment of a degenerated disk. The injection is given under anaesthesia, and it is given forcibly to break down any recent adhesions or to stretch any old adhesions between the disk and the nerve root (these adhesions can frequently be seen at operation). Traction is then applied to open up the intervertebral foramen and is continued for three weeks if it relieves pain. If traction does not relieve pain in seven days, it seldom proves of use.

Radiological Signs.

The radiological signs of lumbar disk disease are not of much help, and they may even be misleading. Contrast myelography is not used. The plain X-ray film may show normal appearances even in old-standing cases. As disk disease is often multiple, the radiograph may indicate only one of two offending disks, or a disk with an old healed lesion may be obvious in the X-ray film while the offending disk may show no radiographic abnormality. The clinical signs and the mobility test are thus much more important than the X-ray findings, both in the making of the diagnosis and in the determination of the operative technique. X-rays are chiefly of value in excluding other conditions and in affording grounds for a decision whether a nerve root should be uncapped—for example, if there is an osteophyte in the intervertebral foramen.¹

Summary.

1. The most frequent cause of low-back pain is a lesion of a lumbar intervertebral disk.
2. The lumbar intervertebral disks are the site of three common pathological lesions—rupture, degeneration and herniation. These may occur with or without root pain or neurological signs.
3. Diagnosis has been greatly simplified. The presence of disk disease, the type of disk disease, and the affected disk or disks can be diagnosed by the history and the physical signs in the back. Diagnosis is just as easy in the absence of root pain and neurological signs as it is in their presence.
4. A knowledge of neurology is not necessary except to determine the technique to be adopted at operation.
5. X-rays are needed only to exclude other conditions and to determine operative technique.
6. The treatment of low-back pain is now becoming a science rather than a matter of guesswork. Every therapeutic measure now advised is used for a definite reason based upon pathological knowledge.

Acknowledgements.

Once again I am indebted to Dr. F. J. Clark, who has done the surgical work; to Dr. M. A. Radcliffe-Taylor for much helpful criticism; to Dr. D. I. Smith, Dr. W. R. Frayne and Dr. D. E. Copping for radiological help; and to many colleagues who have referred patients to me. Sincere thanks are due to Mr. J. H. Hallam, who has done

the cinephotography in an honorary capacity, and to Mr. A. W. Wonsan and Mr. T. W. Marriott, of Kodak (Australia), Proprietary Limited, for many kindnesses.

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RECENT ADVANCES IN THE SURGICAL TREATMENT OF LUMBAR INTERVERTEBRAL DISK DISEASE.¹

By F. J. CLARK, F.R.A.C.S.,

Honorary Surgeon, Perth Hospital; Consulting Surgeon, Children's Hospital, Perth.

To be honest in outlook and purpose in dealing surgically with lesions of the intervertebral disks, one must have in one's mind not only a clear picture of the disability which operative treatment will aim to relieve, but also a full appreciation of the operative difficulties, of the operative damage to normal structures and the adequacy of natural repair of this damage, of the surgical procedure most likely to ensure future freedom from symptoms, and of the necessary post-operative care of the patient.

The surgical approach to the intervertebral disk is possible only through an anatomical area which is generally neglected in anatomical teaching, and which has recently been described in a random communication to *THE MEDICAL JOURNAL OF AUSTRALIA* as "almost incomprehensibly complex". The author of this communication had obviously devoted little thought to this area, carried with him but a vague picture of its anatomical structure and purpose and was therefore unable to appreciate its functional mechanism and the means by which that mechanism could most seriously be disturbed. He might, more honestly, have described this area as that in which diagnostic imagination had surely reached its zenith.

It is not my purpose now to discuss the diagnosis of lesions of the intervertebral disks; this aspect has already been dealt with by the previous speaker. We believe that, in the light of comparatively recent knowledge, it is a fairly simple matter to arrive at an accurate diagnosis. We believe that the degree of accuracy attainable compares more than favourably with the standards of diagnosis of other surgical conditions.

It is my purpose to describe to you, step by step, the procedure which I adopt at the time of operation, the details of technique and the reasons for each detail, the subsequent anatomical and functional aim of the operation, the necessary after-care as we know it at present, and finally to give the results of the treatment described in a consecutive series of cases which, by the passage of reasonable time, may be described as having gone into the post-operative past.

Not long ago I attended a meeting of surgeons at which lesions of the intervertebral disk were discussed. As is inevitably the case when a comparatively new surgical procedure is under discussion, the opinions expressed were, with a few enthusiastic exceptions, extremely cautious. The opening speaker rather decried the work and opinions of the greatest exponent of the surgical treatment of intervertebral disk lesions, Dandy. To my mind this speaker's reasoning was weak and unconvincing. It seems to me reasonable to assume that the surgeon who, by his ingenuity and skill, gave the art of ventriculography to the cerebral surgeon, who by his courage and the perfection of his technique was able to divide the posterior root of the trigeminal nerve in the posterior fossa of the skull,

¹ Lantern slides were shown of X-ray films revealing disk lesions in the lower thoracic and in all lumbar levels and of double and treble disk lesions.

¹ Read at a meeting of the Western Australian Branch of the British Medical Association on October 17, 1945.

would not, in his later years, champion a surgical cause without the same consideration which had resulted in his earlier successes.

Let us realize that the majority of patients who ultimately seek surgical relief from the symptoms of intervertebral disk lesions have been through many months or years of pain and disability which have unfitted them for normal activity. Let us also realize that these are the comparative few whose intervertebral disk lesions have not been cured, often at long last, by conservative treatment and the natural processes of repair. Some there are who, because of the severity of their initial disability, because of the urgency of their pain, demand early surgical relief. These are few. The majority of patients ultimately seeking surgical relief are the pitiful victims of industrial injuries, for whom conservative treatment, rest, manipulations, physiotherapy, injections, weight-extension, and, above all, Nature, have failed. What can operative treatment offer them? What do they demand?

It is not bold to state that the first demand of these unfortunates is relief from pain. In most cases the second demand is restoration to normal activity and working ability. The two demands run hand in hand. It is honest to reply that in a large proportion of cases relief from pain and restoration to normal working capacity will result from adequate surgical treatment. In almost all the remainder relief from pain and a modified working capacity will result. In a few there will be no improvement. With a careful surgical technique the operation will not, in any case, result in an increase of the initial disability.

Operative Procedure.

Anæsthesia.

I have been informed that this operation has been frequently performed under local anæsthesia, during which it has been possible to determine that the intervertebral disks are sensitive to painful stimuli. I can see no real advantage in local anæsthesia, but a real disadvantage, in that the patient must be placed in an uncomfortable position for the best part of an hour.

When general anæsthesia is employed, it is essential that some form of intratracheal tube shall be used, and to this end induction is produced by "Pentothal Sodium" given intravenously, followed by sufficient ether (sometimes with the addition of a cocaine spray of the upper respiratory tract) to enable the passage of the intratracheal tube. The patient is then placed in position, face downwards, and anæsthesia is continued either with ether or with "Pentothal Sodium" introduced through one of the veins on the dorsum of the hand. In either case the intratracheal apparatus is connected to the oxygen supply.

Posture of the Patient.

Posture of the patient is important, and a standard position should always be adopted. The table is tilted into a partial Trendelenburg position and the lower flap is dropped to enable the legs to flex fully at the hip joints. This position ensures that the interlaminar spaces are opened to their fullest extent.

Technique.

After the usual preparation and draping of the operative field the *erector spinæ* muscle on the side through which the approach will be made is well infiltrated with a 1% solution of procaine, to which adrenaline (1 in 1,000) has been added in the proportion of six minims to each ounce of solution. This procedure has a triple purpose. In the first place, the separation of muscle from the spinal processes and laminae is rendered almost bloodless. In the second place the necessary retraction of the *erector spinæ* muscle is facilitated by the local anæsthesia, and finally, patients so treated seem to have less after-pain than those in whom the muscle is not infiltrated.

The skin incision, in the mid-line, is sufficiently long to expose three vertebral spines, two above and one below the level of the suspected disk. The muscle sheath of the *erector spinæ* is incised as close to the spinous processes as possible. The muscle is separated from the spinous

processes and laminae with a broad chisel. The use of such an instrument enables easy clearing of the area and does much less damage to muscle body than knife dissection.

The next stage is important. At this stage the mobility between the exposed vertebrae is examined. This mobility test was first described by Dandy. It is both a confirmation and a correction of the clinical diagnosis. For its proper interpretation there are two essentials; firstly, there must always be a standard position of the patient on the operating table, and secondly, the surgeon must have a fairly considerable experience of the test to achieve accuracy. There is no doubt that my own accuracy in interpreting the findings is now much greater than it was a year ago. The test is performed by seizing the exposed vertebral spines in order and attempting to "rock" each vertebra on its immediate neighbours. For this purpose I find that an upper incisor dental forceps is an ideal instrument. With the patient in the standard position there is little movement to be seen or felt between vertebrae the bodies of which are connected by a normal disk. When there is a damaged disk between vertebrae, the vertebra above this disk rocks noticeably on its neighbour below. This rocking is apparent not only between the vertebral spines, but also between all the exposed portions of the vertebrae concerned. It is sometimes necessary, in confirmation, particularly in the case of large patients whose legs are heavy, to reduce the degree of flexion at the hips by raising the dropped end of the operating table. It must always be remembered that more than one disk may be affected. This is not infrequent, and it may be confidently stated that when two disk injuries are demonstrated by this test, both must be dealt with in the manner about to be described.

Once it has been determined which disk is defective, the next procedure is to clean up thoroughly the lamina of the vertebra above and the *ligamentum flavum* overlying the affected disk. This can best be done by the use of a flat raspatory with a curved end. I cannot achieve the necessary exposure of the affected disk by removing the *ligamentum flavum* alone. By necessary exposure I mean that through which the *dura mater* and the nerve root may be gently retracted, through which possible hæmorrhage may be controlled and yet adequate space provided for the treatment of the disk. More space is obtained by removing a portion of the lamina immediately above. I find that the removal of the necessary portion of the lamina is easily achieved by drilling the lower third of this lamina with a guarded electrically driven drill. This not only saves much time, but also enables the necessary bone removal to be performed with a small bone nibbler.

The *ligamentum flavum* is next removed with a small knife, and any tags remaining are conveniently removed with a sphenoid punch. A neat, small opening results, through which all subsequent manœuvres may be easily performed and in which adequate lighting is possible.

The spinal *dura mater* is now exposed and is pushed medially by the gentle insertion of adrenaline gauze strips between the dura and the lateral wall of the vertebral canal. At this stage it is possible to run into troublesome hæmorrhage from the anterior internal vertebral venous plexus. In the living this plexus is not the fearsome thing portrayed in the text-books of anatomy. It is true that its lateral connecting veins may bleed fiercely if roughly handled. Gentle handling is essential all the time. Hæmorrhage may be controlled by gentle packing above and below with either thin adrenaline gauze or cotton-wool pledgets attached to a thread. Recently this control has been made easier by the availability of thrombin, in a solution of which the pledgets may be soaked.

The disk is exposed. It may be either herniated or degenerated. In the former case a glistening white nodule of varying size projects immediately beneath the normal situation of the retracted nerve root. In the latter case there may be visual evidence of thinning of the *annulus fibrosus*. In any case, if the disk is degenerated, a blunt seeker may be easily pushed into the intervertebral space. This is not possible if the disk is normal. This is an important point and must be emphasized.

If herniation is present, the herniated portion is freed and pulled out. All loose fragments are removed. Whether herniation is present or not, it is essential to remove as much of the affected disk as is possible. This is achieved by means of specially designed instruments, designed for the purpose of overcoming the difficulty of removing a comparatively large damaged structure through a small opening in the depths of a deep surgical wound. I believe that no one should undertake this operation without the instruments necessary for as complete a removal of the affected disk as is possible. Why is a fairly complete removal necessary? It is necessary in the case of the herniated disk because, if removal is incomplete, herniation may recur at the original site or herniation may occur on the opposite side of the same disk. This is not infrequent in cases in which adequate removal has not been achieved. In either case, whether herniation or degeneration has occurred, complete removal is necessary to give full scope to the natural processes of repair, which, it is hoped, will result in permanent stability of the affected area. Does Nature make a good repair of injuries to the intervertebral disks? In many cases she does, as is evidenced by the freedom from symptoms enjoyed, after conservative treatment, by many victims of this disorder. In many cases she fails, as is evidenced by the continuous or intermittent suffering of the victims, in spite of the bony buttressing round the periphery of the affected area which is frequently demonstrated by radiological examination.

Is it possible, at the time of operation, to assist the natural processes of repair by procedures additional to the routine removal of the greater part of the affected disk? I believe that this is possible. It must be remembered that we are dealing with a structure which, since man's assumption of the erect posture, has come to assume the function, not only of a flexible buffer of movement, but also of a support of a great deal of his body weight. When a disk is damaged, it frequently happens that the space it originally occupied between two vertebral bodies becomes narrower, and at its periphery an attempt at bony union may occur. This narrowing is by no means constant, and frequently it does not occur even after a fairly complete removal of the disk. How, then, is stability in this area achieved by operation? We know that natural repair can occur, in many cases, after long periods of conservative treatment. This, at best, is a fibrous union of uncertain strength. As the disk space is almost without blood supply after early life, the natural processes of repair are considerably hampered. Is it not reasonable to assume that, if an adequate blood supply can be provided by operation, repair will be both hastened and strengthened? The obvious source of blood supply is from the vertebral bodies themselves, in which there is highly vascular cancellous bone. If the cartilage plates overlying the ends of the bodies can be removed over a sufficient area to allow cancellous bone to open directly into the disk space, then the way is open for natural repair, which will result in really firm fibrous and possibly bony union. This removal of the cartilage plates is possible by the use of a side-cutting electrically driven burr. The burr designed for this purpose has a smooth, flat end which cannot cut, and therefore there is no forward drilling effect. It can cut sideways only. With this tool it is possible to burr away enough of the cartilage plates of the vertebral bodies above and below the affected disk through the small opening in the depth of the operation wound.

When this stage of the operation is completed the debris resulting from the burring is removed and there is nothing further to be done to the actual disk area.

In many cases in which actual herniation has been present there has been considerable pressure on the nerve root overlying the affected disk. In such cases I make it a practice to uncap the root by removing a portion of the bony roof of the neural canal. This is conveniently done with a Prince's antrum punch. I believe that this manoeuvre provides ample room for any post-operative oedema which may result from retraction of the root and the relief of pressure of the protruding portion of the disk.

The dura and the nerve root fall back into place, and any hæmorrhage which may follow the removal of the wool pledgets or adrenaline gauze soon ceases. If this persists at all, it is easily controlled by a few "squirts" of thrombin solution.

Before the retracted muscle is allowed to drop back into place the wound is lightly powdered with sulphanilamide. The muscle sheath is sutured in a single layer after the legs have been raised. The skin incision is then closed.

Because dressings on the back have an unpleasant tendency to shift from their position, they are made to adhere to the skin by a light application of "Mastisol".

The After-Care.

Surgical shock is extremely rare after this operation. This state of affairs is attributable to gentle handling of the structures encountered and the negligible hæmorrhage with the technique described. For four or five days the patient is kept lying flat on the back with the head supported by one pillow only. Pain is easily controlled by the usual sedatives. After the first few days movement in bed is encouraged and additional pillows are allowed.

In many of the earlier cases on which I operated, the patients were encouraged to get out of bed and commence walking as soon as they were able. Many were walking on the sixth or seventh day. Of these, quite a number made steady, painless progress, were able to leave hospital two to two and a half weeks after operation, and resumed their normal occupations quite soon after. Some, after their initial relief, became so bold that they attempted too much, developed muscular spasms, and went through an unduly prolonged convalescence. In a few cases herniation of the incompletely removed disk developed on the opposite side to that which had been operated upon. In a small number the presence of two affected disks had been overlooked and further operation was necessary.

I now believe that the stay in bed of each patient should be governed to a large extent by his progress. It is necessary to curb the enthusiasm of some and to encourage others who are sluggish. In all cases I believe that the patients should remain in bed for a period of three weeks after operation. During the latter half of this period it is an advantage to have each patient visited daily by a physiotherapist, who will supervise exercises and general movements and who will continue this supervision when the patient is ambulatory. In no case should the patient return to heavy manual labour before three months have elapsed from the time of operation. Steadily increasing activity should be the order from the beginning to the end of the post-operative period. An enthusiastic burst of energy will almost certainly delay return to a normal, painless activity.

If a painful muscular spasm develops during the period of recovery, it may frequently be relieved by the physiotherapist. If necessary, an injection of "BABAN" into the affected area will nearly always give relief. In a few cases a few days' weight extension may be necessary to restore the patient to the stage which had been reached before unwise activity caused the setback. Almost all painful setbacks in the post-operative period are avoidable by strict adherence to a routine of slow and steadily increasing activity. If, in spite of this strict adherence, pain and disability persist for many days, then either the diagnosis or the operative technique has been at fault. As time goes on such cases are becoming very few.¹

Results of Operative Treatment.

It is always easy, and at the same time dishonest, before undertaking the surgical treatment of any disorder, to eliminate or reject those cases which for psychological reasons are likely to be failures and thus spoil the measure of success which may result from the procedure advocated.

In our present mode of life there are many patients who, from the onset of their complaint, are determined that they are entitled to some form of compensation for

¹ A motion picture film in natural colour of a disk operation was shown at this stage.

their injury. Whatever their physical condition when treatment is concluded, they will not admit their recovery unless in most instances some form of financial balm concludes their period of disability. In this attitude they are not entirely blameworthy. They suspect, not without reason, that alleviation of symptoms may be only temporary, that as a result of the damage of the original injury they may be permanently susceptible to future injury and incapacity. The results of treatment in such cases may well spoil any series.

In the series of cases the results of which I am about to describe, no patient was rejected for surgical treatment after it had been decided that such treatment was the procedure indicated. This series of 45 consecutive patients, drawn from all walks of life, does not include the few service patients on whom I operated during the period. It does include a variety of occupations, some gentle and some strenuous—from that of a nun to that of a wharf labourer. All these patients have been operated on and their post-operative treatment has been concluded over six months. Of the 45, 24 have returned to their normal working life without disability, six have returned to their normal life and are able to carry on with trivial disability, four are fit for sedentary work only, the treatment of five has been a failure, and six are under observation from time to time.

There is little to be learnt now from the 30 cases whose treatment may reasonably be described as successful. They are at work as a result of the treatment you have heard described. Let us consider the remaining 15 cases, which cannot be considered satisfactory.

Of the four patients listed as fit for sedentary work only, the first is a man who had had intermittent symptoms for five years. At operation eight months ago a herniated fifth lumbar disk was discovered. He was kept in hospital for only fourteen days after operation. His condition is improved, but he has pain on attempting strenuous work. The second is a man who had symptoms for twenty months. He had a herniated fourth lumbar disk and was kept in hospital for seventeen days after operation. He complains of pain on lifting. The third is a man who had had intense sciatica for three months. At operation a herniation of the fifth lumbar disk was present. He was kept in hospital for thirty-two days after operation. He now has pain on sitting and weakness of plantar flexion on the affected side. He has lost his flexion deformity and has no sciatica. The fourth is a woman who had had severe leg pain intermittently for six years. She was kept in hospital for thirteen days after the removal of a herniated fourth lumbar disk. She has lost her leg pain, but now has symptoms of a degenerated lumbar disk.

It is noticeable that in three or four of the cases the stay in hospital was too short. I feel also that clearing of the disk space was insufficiently complete and that the stability of the area has not been adequately restored. In the third case I believe that retraction of the nerve root during operation may have resulted in some damage to that structure.

Of the five cases listed as failures, the first was an early case in which abnormal mobility was found between the first and second lumbar vertebrae. As no bulging of the disk was found, the operation was abandoned. The patient's symptoms remain and he is prepared to be operated upon again. The second case was the first of a degenerated disk recognized in the series. The disk was inadequately dealt with. It was only scraped out with a small curette. No improvement at all has occurred. The third case was one of herniation of the fourth lumbar disk. The removal was inadequate and the disk herniated (and still does so) on the opposite side. The fourth case was one of fifteen years' standing. The fourth lumbar disk was degenerated. The nerve root was uncapped, but the disk itself was inadequately dealt with. The patient left hospital on the ninth day. The fifth case was almost a replica of the second; the operation was inadequate.

These failures are due either to a lack of judgement at the time of operation or to an inadequate technique and the lack of the necessary equipment for the fulfilment of the operative aims.

Of the six patients listed as under observation, the first had a degeneration of the first lumbar disk. At the time of operation the fifth lumbar disk also was suspected, but was not properly investigated. This has since been operated on, and a herniation of the fifth disk was found and dealt with. There is now no evidence that the first disk is causing symptoms, and it is too early after the second operation to assess the result. The second patient has also been operated on twice. At the first operation an obvious degeneration of the fourth disk was dealt with, but a herniation of the third disk was missed. This was dealt with later, and it is too early to assess the result. The third case was one in which, as a result of inadequate removal of the fourth lumbar disk, herniation of the remaining portion occurred on the opposite side. After the second operation a hæmatoma formed and became infected. In the fourth case a hæmatoma developed after the removal of a herniated fourth disk. The fifth patient left hospital fourteen days after operation on a degenerated fourth disk. The sixth case was that of a woman who had already obtained complete relief from symptoms after operation for a cervical disk. She had had symptoms of a lesion of the fifth lumbar disk for six years. She is now waiting further operation, as at the time of operation on the lumbar disk either the removal of the fifth disk was inadequate or a lesion of the fourth lumbar disk was missed.

It is noticeable that in this group there has been evidence of both faulty diagnosis and faulty technique. It must always be remembered that the presence of two disk lesions is not uncommon.

Conclusion.

After the analysis of this series of earlier cases I am left with the belief that, in spite of the occasional inaccuracies in diagnosis and in spite of the comparatively inadequate surgical technique which was employed, the results, as a whole, have justified the form of treatment adopted. With more accurate diagnosis and with the much more adequate and thorough technique which has been employed in a later and larger series of cases, I believe that, when these come to be analysed, the results of operative treatment will have improved.

Reviews.

DISEASES OF THE NERVOUS SYSTEM.

THERE is no subject on which F. M. R. Walshe has written that he has not illuminated. Diseases of the nervous system are described in his textbook for the practitioner and student.¹ However, the neurologist will also gain from its perusal. The book is written after many years of clinical experience by the possessor of a critical faculty far above the ordinary. The writer has a lucidity of expression which is given to few and occasional brilliant flashes of wit add to the interest of perusal. He aims to seize the student's interest, at the same time to set his mind free from the burdensome mass of detail which only too often creates a false impression of the difficulties of neurology. Most clinicians find that the student, coming from his anatomy course, knows much more about the bundle of Vicq d'Azyr, because the name has caught his waning interest, than about the tracts of the spinal cord. Walshe ruthlessly maintains perspective. His clarity of thought is very apparent in therapy, in which British medicine differs so fundamentally from the continental schools. No lists of modes of treatment which may be tried are supplied, and reasons are given for the avoidance of some treatments which are in common use. Nothing is advocated which will not benefit the patient.

No one reading this book will fail to benefit, and there is no better foundation or guide to the study of neurology.

¹ "Diseases of the Nervous System", by F. M. R. Walshe, O.B.E., M.D., D.Sc., F.R.C.P. (London), Hon.D.Sc., Nat. University, Ireland; Fourth Edition; 1945. Edinburgh: E. and S. Livingstone Limited. 8½" x 5½", pp. 376, with many illustrations. Price: 15s. net.

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THE INTERVERTEBRAL DISK.

In 1943 the late Sir Arthur Hurst wrote an article on the treatment of sciatica which he called an essay in debunking.¹ He quoted views of many authors. These were curiously divergent and dogmatic. One author, writing in 1942, holding that the pain in sciatica was almost always muscular, obtained almost instantaneous and permanent relief for his patient by the injection of a local anesthetic solution in a myalgic area. Opposed to these ideas were those of three authors, expressed in 1943, that all cases of sciatica were due either to direct pressure by a herniated intervertebral disk or to a reflex neuralgia from a small, well-localized painful area in the fibrous tissue of the lower part of the back. In the face of opinions such as these, Hurst had justification for his attempt at "debunking". Attempts of this kind are salutary for members of the medical profession, especially for practising clinicians to whom the *post hoc* so easily becomes the *propter hoc* and in whose eyes successes in treatment cannot do other than overshadow failures. Moreover, inventive genius can excuse many a failure and resourcefulness suggest without delay another possible remedy. However, as Geoffrey Jefferson wrote in the *Medical Annual* of 1944, there are few today who deny that the most common cause of sciatica is rupture of the intervertebral disk. In these circumstances the clinician must keep always before him two objectives—accuracy of diagnosis and a display of wisdom in the choice of treatment. In both these matters, and particularly in the latter, his vision will be clearer if he is prepared to do a little debunking himself, if he tries to keep an open mind and to avoid the path of specious argument and spectacular promise that sometimes ends in disappointment and distress. Lesions of the intervertebral disk are of such importance that they have earned a well-deserved notoriety and it is not to be wondered at that three of the six Australian Branches of the British Medical Association

have held discussions during which reference was made to intervertebral disk lesions. The papers read at these meetings are published in this issue and merit the careful attention of all clinicians.

In regard to diagnosis, no attempt can be made to cover the whole subject in detail. Emphasis will be laid on two aspects. At the outset all practitioners will agree that nothing must be done which will open the way for the patient to graft a neurosis onto the disability arising from any pathological lesion from which he may be suffering. In this matter sins of omission are just as potent as sins of commission. Both must be avoided from the time when the patient first comes to the clinician seeking advice. To begin with there should be no unnecessary delay in either diagnosis or treatment. A. V. Meehan in his paper has suggested that delay in accurate diagnosis and treatment often leads to a sense of frustration. Nothing could be worse for a patient with a disability of the back. Meehan thinks that delay is likely to occur in compensation and service cases, but available information would suggest that delay is just as likely to be suffered by patients in other circumstances. Diagnosis should be made with as little as possible of what is known in stage-craft as "business"—there should be neither fuss nor display, complicated tests should if possible be avoided and all apparatus for the performance of tests reduced to a minimum. Sometimes complexity in tests and apparatus is necessary, though as time passes these occasions appear to be becoming less frequent. R. A. Money has described the special investigations that are used. There is no doubt that by their means important information may be gained. On the other hand a correct diagnosis can often be made by simpler means. J. H. Young holds that the presence of disk disease, the type of disk disease and the affected disk or disks can be diagnosed by the history and the physical signs in the back. In this contention he is in line with such investigators as W. E. Dandy, of Baltimore. Writing in *The Journal of the American Medical Association* of October 24, 1942, Dandy stated that since the diagnosis could be made with almost absolute accuracy by the clinical symptoms alone, lumbar puncture and injection of contrast media such as air, iodized poppy seed oil and "Thorotrast" into the spine were entirely unnecessary: He went so far as to declare that methods of this kind were in fact strongly contraindicated, for the small disks did not show with any contrast media, and if dependence was placed on the findings, the patient was denied the operative treatment that provided the only cure. The only valuable objective finding in Dandy's opinion is a diminution or loss of the Achilles tendon reflex, and this, he states, occurs in only about half the cases. That the singular view put forward by Dandy, however desirable it may be to cleave to simple methods, is not that of all workers in America is clear from a study published by O. R. Hyndman, A. Steindler and J. Wolkin in *The Journal of the American Medical Association* of February 6, 1943. They discuss the use of an intraspinal injection of iodized oil and state that there are certain cases in which the method should be used for precise confirmation. The subject is important and there is no doubt that the present-day tendency is to dispense with radiological examination and the use of radio-opaque substances. Jefferson, who has already been quoted, writes that we are at present in an interim stage in the disk problem. As time goes on,

¹ *British Medical Journal*, December 18, 1943, page 773.

myelography, he thinks, will be gradually abandoned unless the presence of a spinal tumour is suspected.

Our present purpose will best be served in the matter of treatment by reference to an analysis that has recently been made from the industrial point of view by H. C. Marble and W. A. Bishop.¹ Their paper, which was presented at a war seminar on industrial medicine and surgery at Chicago in July, 1944, comes from the American Mutual Liability Insurance Company at Boston. Both authors are medical officers of this company; also Marble is visiting surgeon of the Massachusetts General Hospital and Bishop is associate physician of the same institution. It was from Boston that the first reports of successful operation for herniation of the *nucleus pulposus* came in 1933. The authors point out that the material dealt with by them comes from one of the largest insurance companies in the United States and that the facts represent a cross-section of the work of neurosurgeons and orthopaedic surgeons throughout the country. In their series were 496 cases in which herniation of the intervertebral disk was thought possibly to have occurred. Operation was performed in 92 of these cases; this is approximately 20% of the total; in 80% other treatment was adopted. From the total of 92 cases all questionable cases had been eliminated—those in which there were complications, fractures or other lesions which might complicate the picture. A result is described as excellent by the authors when the patient was able to resume his former occupation at approximately his former rate of pay within a period of six months. Thirty-four of the 92 patients achieved an excellent result. A result was described as fair when the patient returned to work within a year, and there were nine in this category. No less than 49 of the 92 patients had a disability which lasted for more than a year and the result was classified as poor. In some of the cases the disability was continuing when the authors wrote and many were still "out of work". Presumably the words "out of work" mean that the patient was unable to work. Among the patients whose results were excellent there were four on whom fusion had been carried out; one of the patients with a fair result had been subjected to fusion and among those with a poor result were 23 on whom this operation had been performed. These figures, it is stated, agree with the findings of Mixter that the vast majority of failures occurred in cases in which fusion had been carried out. Age was not found to be a factor in the production of the different types of result. The compensation cost of a back injury was found, as might be expected, to be directly related to the results of therapy. The total cost of a poor result was more than six times that of a favourable end result. Of the 92 cases all were traumatic; 62 were classified as strains, 19 were due to falls with contusions and 11 were due to twisting. The ability of neurosurgeons to make a pre-operative diagnosis was about the same as that of orthopaedic surgeons. A neurological diagnosis was made in 73 cases, and in 53 of these the diagnosis was confirmed at operation; the diagnosis of 54 orthopaedic surgeons was confirmed in 44 cases at operation.

The figures set out by Marble and Bishop are instructive. By and large the results are not so good as those claimed by individual workers. They show the general results that may be expected; there is no indication of

the extent of the operations and it would have been interesting had the numbers of surgeons concerned been given. Though the results of one surgeon working on a fixed routine of diagnosis and perhaps of operative technique may be better, even much better, than those set out by Marble and Bishop, surgical operation is clearly not a panacea. Sometimes it is the only form of treatment likely to bring relief to the patient; sometimes it may be futile. If possible operation should be avoided; but if it has to be undertaken, operation, like diagnosis, must not be too long delayed. One of the speakers at the Chicago seminar reminded those present that protruded disks had existed for thousands of years, that people had lived with them until quite recently and that the end results of surgical procedures were not known. Of this fact we should not lose sight. What needs to be discovered is what change takes place in the disk that renders it susceptible to injury and why the change occurs.

Current Comment.

TOOTHACHE AND FOLK-LORE.

THE days of superstition applied to matters of health are by no means past; in this connexion it is unnecessary to recall the lucrative activities of "unqualified practitioners" of all types. However, it is of interest to learn how some of the strange beliefs have arisen. In his C. E. Wallis lecture, entitled "The Folk-Lore of Toothache", J. D. Rolleston gives an account of some ancient ideas of the origin of toothache and of some of the quaint methods of cure that have been (and in some cases still are) practised.¹ The worm theory of the causation of toothache was the most widespread, and it still persists in some parts of Germany, Madagascar, China, the Philippine Islands, Scotland, the Orkney and Shetland Islands, the Isle of Man, Devonshire, Yorkshire and elsewhere. The antiquity of the belief is shown by the fact that the earliest reference to it appeared in a papyrus of the twentieth dynasty of Egypt (1200 to 1100 B.C.). (Incidentally, examination of skulls has shown that the ancient Egyptians must have suffered tortures from toothache.) Toothache was also prevalent in ancient Greece, and in Rome many notable lay writers referred to it; among these were Pliny, Catullus, Horace and Martial. Cato the Censor, who disliked the medical profession, recommended for toothache his favourite panacea, frizzled cabbage.

The cures for toothache propounded from ancient times have been classified by Rolleston into several types, the first being human remedies. The most startling of this group is the idea of washing out the patient's mouth with his own urine, provided that he was in good health. This was warmly recommended by Fouchard, who, however, made the following observation: "One has a little difficulty at first in getting accustomed to it, but what does one not do for one's repose or health?" What, indeed? Curative powers were supposed in folk-lore to be inherent in corpses, and the use in various ways of corpses' teeth (extracted in numerous bizarre fashions) was recommended in a number of places. Rolleston's second group consists of animal cures, which vary from the hanging round the patient's neck of the head of a mouse or weasel, bitten off the live animal by the patient, to the kissing of a donkey's back, or the achievement of running three times round a church without thinking of a fox. The last-mentioned, through the sheer perversity of the human consciousness, would be certain to be most difficult of attainment. Plant cures comprised the use of a varied assortment of plants, the most frequent being hyoscyamus, bellitony of Spain, betony, garlic, elecampane, peony and

¹ *The Journal of Industrial Hygiene and Toxicology*, April, 1945.

¹ *The British Dental Journal*, April 20 and May 4, 1945.

hyssop. Various types of trees were also involved; the bark was chewed or the tree was invoked in prayers of set forms. Among the mineral remedies are mentioned alum and verdigris for their good effect on ulcerated gums, inhalation of the fumes produced by the pouring of oil on red-hot iron, the chewing of finely granulated gunpowder, the application of salt to the aching tooth or its use as a mouthwash, and water for its diaphoretic effect. Transfer of the toothache to another person, animal or plant by a number of means was also a popular remedy. One charming example is as follows: "The patient stands on the ground, under the open sky, and spits into a frog's mouth, asking it to take the toothache away, and then releases it. The ceremony must be performed on a lucky day and at a lucky hour." One belief in England is that if the gums are cut with an iron nail which is driven into a wooden beam, the victim will never have toothache again as long as he lives. Hydrotherapy covers the use of water in various peculiar ways. Wells have played a very prominent part; in general sufferers seem to have drunk from the well a certain number of times or in a certain way, repeating prayers to the Father, the Son and the Holy Ghost. Brooks also are mentioned; running water is supposed to carry away the trouble. One cure, slightly different from the others, consists in the drinking of water taken from the tops of three waves; this comes from Foula, Shetland. Charms against toothache appear to have been first mentioned in a Babylonian legend of 3000 B.C. Professional charmers for toothache have not been extinct for very long; it is on record that W. G. Black, writing in 1883, knew of a man practising in Cheshire during the preceding twenty years; moreover, during the last forty years, a professional charmer near Kilmarnock cured toothache by driving a nail into the beam supporting the roof of his house. Charms during the Middle Ages were dedicated to one or more members of the Trinity, to the Virgin, to various saints (especially Saint Apollonia) and to the moon (especially the new moon). Sometimes they were in Latin, sometimes in English, sometimes in a mixture of both or a queer jargon. They were spoken or written. Fraud played a considerable part in their application. The tale is told of a young woman who was given a sealed paper to guard her against toothache, but was finally persuaded by her priest to open it. All that was found was the following:

Good Devil, cure her,
And take her for your pains.

Patron saints are important in the folk-lore of various diseases. Saint Apollonia is the principal patron saint of dentistry and the patron saint for children's dentition. Saint Cosmas, Saint Damian and Saint Laurent are the patron saints of dentists. But these are not all; the total number of patron saints connected with dentistry is over twenty. Saint Apollonia, the chief patron saint, died in A.D. 249, at Alexandria, having had her teeth knocked out and being burnt. She has been variously described as "a virgin of advanced age" and as "a young and beautiful maiden". The treatment of toothache by the mechanical method of filling up the hole is only infrequently alluded to in folk medicine. However, when the method was used, an assortment of weird substances are recorded as plugging agents; these include the ashes of burnt mouse dung (mentioned by Pliny), cerumen, coral, elecampane, galingal, gunpowder, hartshorn, henbane, oak apple, pepper, sage and tobacco. Tooth extraction is a different matter; folk-lore provides much evidence of its practice. At the present time, in Styria, extraction may be carried out by the following: peasant doctor, his wife, the midwife, the bone-setter, the surgeon, the tooth-drawer, the smith, the fayer, the bleeding and cupping men and women, the faith-healer, the storekeeper, the pharmacist and the minister. These persons used a key or bent nail. The Japanese are said to be skilled in the extraction of teeth with their fingers alone. All over Europe and in Japan, to dream of a tooth's being pulled out is believed to presage the death of a relative; an upper tooth indicates the death of an aged relative and a lower tooth that of a young relative. According to some

English beliefs, the day of the week on which a tooth was extracted was important, each day representing some result, either fortunate or unfortunate. Folk-lore also takes note of the relation of pregnancy to tooth extraction. Rolleston states that in Germany it is popularly believed that tooth extraction is apt to be followed by a miscarriage, and that every child costs a tooth; the latter of these two ideas is by no means defunct in Australia. Rolleston concludes his fascinating catalogue with a group of miscellaneous cures. "In Sussex, they say, if you always clothe your right leg first, you will never suffer from toothache." In Shropshire, however, the contrary is held. "To avoid toothache never shave on a Sunday." Other queer cures for toothache include the wearing of a cord round the loins and smoking in the privy on Good Friday. Rolleston remarks in the course of his address that the multiplicity of cures for toothache in folk-lore is proof of their inefficacy. Although there may still be some temptation to try any or all of these remedies that have been so obligingly collected for us, we still feel that in the end there will be nothing for it but the dentist with his drill and forceps.

PULMONARY EOSINOPHILOSIS.

In 1940, a pulmonary disease to which they applied the descriptive and non-committal term "pseudo-tuberculosis with high eosinophilia" was discussed by Frimodt-Møller and Barton. The symptoms and clinical signs are similar to those of tuberculosis, and the radiographic appearances suggest extensive, bilateral tuberculosis with fine lesions of the millary type. The prognosis is favourable. Large numbers of cases have been reported from India. The high incidence in such a country immediately suggests the possibility of helminth infestation as a cause. But Frimodt-Møller seems to have ruled this out. He is inclined to the view that it is allergic in origin; but he admits the possibility that there are several causes. Recently, R. Viswanathan has made a number of further interesting observations.¹ During a period of fourteen months in an Indian general hospital, he made a diagnosis of "pulmonary eosinophilosis" in 85 of 946 cases with symptoms of respiratory disease. He recognizes acute and chronic types. The acute type was diagnosed in eight cases only. It is characterized by sudden onset, fever, cough, breathlessness, bronchial spasm and lassitude. Expectoration is scanty. Recovery occurs spontaneously in two to four weeks. In the chronic type the onset is insidious and the duration three months or longer. Viswanathan noted that where the duration was longer than six months remissions had occurred. Intermittent fever is frequent. Cough is the main symptom. It is sometimes productive, the sputum being thick and viscid; in some cases cough occurs in paroxysms, particularly at night. Asthmatic symptoms occur in some cases. Viswanathan does not mention loss of weight; but this symptom and sometimes hæmoptysis occurred in Frimodt-Møller's series. In Viswanathan's cases the leucocytes were invariably increased in numbers, the highest count being 50,000 per cubic millimetre. The proportion of eosinophile cells varied from 15% to 80%, the highest proportions on the whole occurring in the highest leucocyte counts. Clumps of eosinophile cells are seen in the sputum. Viswanathan reports a phenomenon that has not been observed before, namely, a high titre of cold agglutination. Treatment by the intravenous injection of arsphenamine has been employed by Viswanathan. He gives 0.15 gramme as an initial dose, then 0.3 gramme every five days. The injections are stopped when all symptoms have disappeared. The count of eosinophile cells increases sharply after the first injection. The eosinophilia disappears with the symptoms. Viswanathan suggests that the disease is caused by a virus.

There seems to be no doubt that this is a newly discovered disease. As rather large numbers of cases occur, the cause will probably be revealed before long. The progress of research will be followed with interest.

¹ *The Indian Medical Gazette*, August, 1945.

Abstracts from Medical Literature.

RADIOLOGY.

Calcification in the Ascending Aorta.

JAMES JACKMAN AND MORTIMER LUBERT (*American Journal of Roentgenology*, May, 1945) have reviewed the radiological, pathological and clinical findings in 66 cases of syphilitic aortitis examined *post mortem*. Linear calcification in the ascending portion of the aorta was present on the radiographs in 22.7%. Comparison by radiological methods has been made with 62 cases of severe arteriosclerosis of the aorta in which autopsy was performed. Only 3.2% in this group were found to have calcium deposits visible in the ascending aorta. The authors conclude that linear calcification in the ascending aorta is a valuable radiological sign of syphilitic aortitis. When calcification in this location is present, its reliability may surpass that of negative serological evidence. Calcification in the ascending aorta is not an early sign of luetic aortitis and occurs most often in older, relatively quiescent cases of syphilis.

Cardiac Changes in Arterio-Venous

Fistula.

R. C. PENDERGRASS (*American Journal of Roentgenology*, May, 1945) states that arterio-venous fistula is a common vascular injury of modern warfare. Cardiac dilatation and hypertrophy, with eventual failure, may result from the establishment of such a fistula. The cardiac changes may be demonstrated radiographically. Radiologists should be familiar with this particular cardiac effect and suspect the presence of a fistula in patients with cardiac enlargement who have suffered from penetrating wounds. The cardiac changes in arterio-venous fistula are usually reversible by surgical elimination of the fistula. Temporary manual occlusion of the fistula produces no appreciable change in the cardiac silhouette, but further study is indicated as to the effect of prolonged compression. The immediate post-operative effect is an increase in heart size, with a decrease beginning in twenty-four hours, more evident at forty-eight hours, and usually well established by the seventh day after operation.

Radiological and Gastroscopic Findings in Antral Gastritis.

WALTER W. VAUGHAN (*Radiology*, June, 1945) describes three types of antral gastritis: (i) an acute oedematous process with involvement primarily of the mucosa and submucosa; (ii) ulceration of the mucosa with involvement of the *muscularis submucosa*; and (iii) a chronic inflammatory process with hypertrophy of the mucosa and round-cell infiltration of the *muscularis submucosa* extending down to the serosa. Any pathological infiltration of the gastric mucosa, submucosa or gastric wall will produce some change in the mechanism of peristalsis. The degree of aberration will depend upon the location, extent and type of lesion. Since the antrum is the most important part of the stomach so far as motility

is concerned, it is obvious that antral lesions will produce the greatest changes in motility. In correlating the radiological, gastroscopic and pathological findings in 576 patients studied gastroscopically, the author has found the antral systole and motility of the mucous membrane to be the most accurate and valuable radiological and gastroscopic observation in the detection of early pathological changes in antral gastritis. Enlarged mucosal folds are apparently of no significance unless ulceration can be demonstrated. The radiological findings vary from a temporary and persistent spasm of the antrum, with impaired irregular and ineffective peristaltic waves producing abnormal antral systole, to a constant filling defect such as may be seen in an antral or prepyloric carcinoma. If the lumen of the antrum is still patent so that a small amount of barium can be forced through, ulceration can frequently be demonstrated. The most characteristic clinical findings are: epigastric pain, which is usually made worse by food; nausea, especially in the morning; weight loss, and occasionally gastric hæmorrhage.

Fibrous Dysplasia of the Skull: A Probable Explanation for Leontiasis Ossea.

DAVID G. PUGH (*Radiology*, June, 1945) regards fibrous dysplasia of bone as a developmental anomaly having its onset in childhood. When more than one bone is involved, there is a tendency for the lesions to be predominantly unilateral, but in many cases extensive bilateral involvement is present. Pain, disability and deformity are usually present, often owing to pathological fractures. When maturity has been reached, either no further progression of the lesions takes place or their progress is very slow. Pathological fractures may occur at any time, however. The serum phosphorus content in cases of this type is normal. The concentration of serum calcium is normal or slightly elevated, and that of serum phosphatase moderately or greatly elevated. The increase in serum phosphatase content is in direct proportion to the extent of the skeletal involvement. There is no evidence of hyperparathyroidism. The radiological appearance of long bones which are involved by polyostotic fibrous dysplasia has been described many times. On the other hand, sufficient attention has not been paid to the changes in the skull. The radiographs in cases of polyostotic fibrous dysplasia, with or without Albright's syndrome, which have been reported in the literature, show changes in the skull that are distinctive and fairly consistent. Lesions involving the vault, the occiput and the mandible resemble closely the type of change which occurs in the long bones. The lesions in the frontal, sphenoid, ethmoid and maxillary bones are different. In these regions the bone appears to be densely sclerotic. It is abnormally thick and the paranasal sinuses often are completely or partially obliterated. The density of the bone may be as great as that of an osteoma. Lesions of the skull in polyostotic fibrous dysplasia may cause asymmetry of the vault or face. The deformity may be predominantly unilateral, but there is almost always some bilateral involvement. Deformity of one orbit is not infrequent, and ocular proptosis

may be present. Prominence of the frontal bone, maxilla or mandible is often observed. The similarity or rather identical nature of the lesions of fibrous dysplasia of the bones of the skull and those lesions which have been called *leontiasis ossea* cannot be discounted. Since *leontiasis ossea* is not a specific disease, but merely describes a type of deformity, one cannot say that there is but one method of pathogenesis. In most cases it seems probable that *leontiasis ossea* is a manifestation of fibrous dysplasia of the bones of the skull.

Lobar and Segmental Collapse of the Lung.

L. L. ROBBINS AND C. H. HALL (*Radiology*, September, 1945) state that segmental collapse of the middle lobe of the right lung is seen more frequently than complete collapse. The lobe has two main segments, the antero-medial and the postero-lateral. The former is more often involved in collapse than the latter. Collapse of the antero-medial segment is difficult to differentiate from collapse of the entire lobe, since in both instances the outline of the right border of the heart is at least partially obscured. Only by careful scrutiny of the shape and location of the shadow of increased density, and by the observation that the minor septum is still demonstrable in a relatively normal position, can it be determined that collapse is confined to the antero-medial segment. In the postero-anterior radiograph the shadow of increased density appears directly in apposition with the right heart border and does not extend laterally as far as that of the entire lobe. In the lateral projection, the shadow tends to lie more anteriorly and inferiorly than in collapse of the entire lobe. If, on the other hand, the postero-lateral segment only is involved, the definition of the right border of the heart, in the postero-anterior radiograph, will remain sharply defined, as the area of density is in the posterior portion of the area ordinarily occupied by the middle lobe. The portions of the major and minor septa adjacent to this shadow are lost, but the remaining portions are clearly visible, indicating that the antero-medial segment is aerated.

Osteogenic Sarcoma and Chondrosarcoma.

E. P. PENDERGRASS, J. O. LAFFERTY AND R. C. HORN (*American Journal of Roentgenology*, September, 1945) have reviewed the radiographs and histories of a series of cases of osteogenic sarcoma and chondrosarcoma. Sclerosing osteogenic sarcoma is described as occurring characteristically on the shaft side of the epiphyseal zone and showing mottling due to destruction and sclerosis within the bone. In some instances the growth extends beyond the epiphyseal zone. The cortex is incompletely preserved, although in spots it is obscured by calcification extending into the periosteal and medullary zones. The periosteum is raised above or below the tumour; this causes periosteal lip-ping or the so-called "Codman triangle", and spicules of new bone are laid down perpendicular to the cortical surface, the shaggy "sun-ray" appearance being produced. Extension into the soft tissues may be present. Osteolytic osteogenic sarcoma manifests

itself by a central area of irregular destruction which eventually extends through the cortex. It is asymmetrically located and there is periosteal reaction. The soft tissues are often involved. In many cases the two types are coexistent, and these cases exhibit more definitely the findings which have been described by Codman as occurring in every osteogenic sarcoma. These are tumours of invasive character with combined central and subperiosteal involvement in which fragments of the shaft remain. They may be osteolytic, osteoblastic or both, and there is involvement of the soft tissues. If these characteristics are not fulfilled, one must suspect that the condition is not osteogenic sarcoma.

Radiation Necrosis of the Calvarium.

J. D. CAMP AND R. D. MORETON (*Radiology*, September, 1945) report five cases of necrosis of the calvarium and review the condition briefly from the pathological standpoint. The process is an aseptic necrosis due to strangulation of the blood supply. The calvarium is composed of three layers of bone, a compact layer on each side of a spongy layer. It is supplied by end arterioles from the periosteum. Because both secondary and scattered rays increase in proportion to the hardness of the tissue or amount of calcium present, the structure of the calvarium is well suited for the development of radiation necrosis. The fact that the calvarium does not function as a weight-bearing structure, and therefore presents no symptoms due to the necrosis, may have contributed to erroneous diagnoses and resulted in failure to establish the true incidence. Aseptic necrosis of the calvarium must be differentiated from multiple myeloma and metastatic carcinoma. A previous examination of the skull which has failed to reveal an abnormality, followed by evidences of punched-out portions limited to regions which have been treated, and absence of any signs of this condition elsewhere in the skeleton plus biopsy whenever possible, provide differentiation. In none of the authors' five cases were symptoms referable to the necrosis. Since the calvarium is not a weight-bearing structure, the condition is not so dangerous as necrosis in the hip. In view of the length of time during which these patients survived after treatment and of the fact that in several instances irradiation was the only therapy offered, it does not seem necessary to sacrifice radiation dosage because of the possibility of an aseptic necrosis in the calvarium.

PHYSICAL THERAPY.

Refrigeration Anaesthesia.

C. R. LAM (*Archives of Physical Medicine*, January, 1945) states that recently there has been considerable investigation of the use of reduced temperature as a therapeutic measure. Refrigeration anaesthesia has a sound experimental basis, as shown by work carried out on animals. Allen, Crossman and their co-workers gave this method of anaesthesia a good clinical trial in amputation among "poor risk" patients at the New York City Hospital. They

were able to reduce the mortality rate to less than 20% in these cases. The tissues are refrigerated and not frozen, and it has been decided that a temperature of from 1° to 5° C. is best. The most commonly used method of reducing the temperature is with ordinary ice. It takes from two to three hours to prepare a limb for amputation. Three hours before operation a quarter of a grain of morphine sulphate is given, and three ice bags are strapped round the upper part of the thigh. This permits the application of the tourniquet half an hour later. The tourniquet must be applied with great care so that all arterial supply to the limb is cut off. The head of the bed is elevated and the leg is placed on a large rubber sheet; about three buckets of ice are placed round the leg and the limb is wrapped in a sheet so as to enclose the ice. Blankets are placed outside the sheet. Operation is done two or three hours later, depending on the size of the limb, and the ice is left in place until just before the application of the skin antiseptic. In the author's experience there has been no complaint of pain and there has been little or no change in the pulse or blood pressure. The patients are allowed to get out of bed as soon as possible. The method has been used particularly in cases of arteriosclerotic and diabetic gangrene particularly in those cases in which the risk of post-operative complications was the greatest. The only disadvantage appears to be some retardation of wound healing in some cases.

Röntgen Irradiation in the Treatment of Marie-Strümpell Disease.

J. E. HEMPHILL AND R. J. REEVES (*American Journal of Roentgenology*, September, 1945) present an analysis of 160 cases of Marie-Strümpell disease in which the patients were treated by deep X-ray therapy in addition to orthopedic measures. This disease, which is otherwise called "ankylosing spondylarthritis", characteristically begins in the sacro-iliac joints and extends upward. It is important that the disease should be recognized early and that proper therapy should be instituted in the early stage. Careful history taking and repeated skiagrams will usually lead to an accurate diagnosis if the physician has the condition in mind. The technique employed in this series included the following factors: 200 kilovolts; a distance of 30 to 50 centimetres; infiltration of 0.5 millimetre of copper plus 1.0 millimetre of aluminium; half value layer 1.1 millimetre copper. Three or four elongated fields are used for the spine, and a triangular field for the lumbo-sacral and sacro-iliac joints. Two or three fields are treated every day, a dose of 150r (measured in air) being given to each field for three or four treatments, or a total dose of 450r or 600r per field. Young women are given less dosage in order to decrease the depth dose at the ovaries. The series of treatments is repeated at the end of six to eight weeks if considered necessary. Of 108 patients, 68% stated that they were able to do more work than before treatment. Thirteen patients who were bed-ridden for months and unable to work at all returned to gainful occupation after X-ray treatment. The authors conclude that X-ray therapy has a definite place in the treatment of

this disease, and that its greatest value is that it allows orthopedic correction and prevention of otherwise inevitable deformities to be tolerated because pain, stiffness and paravertebral muscle spasm are reduced. Spinal motion and chest expansion are improved. Elevated sedimentation rates are usually reduced. Pulse rate decreases, haemoglobin value rises and patients begin to gain weight. An explanation of the mechanism of action of X-ray therapy in this disease is given.

Survival after X-Ray Therapy of Mammary Carcinoma.

F. R. GRATZKE AND K. W. STENSTROM (*Radiology*, January, 1945) present an analysis of cases of carcinoma of the breast from the Cancer Institute, University of Minnesota Hospitals, during the years 1926 to 1938. In most of the cases a radical mastectomy was performed; in a few, simple surgical removal of the breast preceded irradiation with X rays. In the analysis, the period of survival is considered from the day of the first X-ray treatment. Three hundred and twenty-four patients received post-operative prophylactic therapy, with a three-year survival of 210 (65%), a five-year survival of 129 patients out of 254 treated (51%), and a ten-year survival of 37 out of 128 treated (29%). Four hundred and seven patients were treated for recurrent, metastatic and inoperable lesions, with a one-year survival of 223 (55%); 29 patients out of 333 survived for five years (9%). The period of survival is considered from the day of the first X-ray treatment. It is pointed out that early diagnosis and immediate radiation treatment following radical mastectomy gave the best results. Statistics from various clinics show a much higher percentage of five-year and ten-year survivals with combined surgery and radiation than with surgery alone in Stage II carcinoma of the breast.

Kaposi's Sarcoma.

C. J. HANSSON (*Acta Radiologica*, October, 1940) gives an account of the clinical and radiotherapeutic features of 23 patients with Kaposi's multiple idiopathic hemorrhagic sarcoma. Italian, Russian and Polish authors are responsible for most of the literature on this disease. Of the patients in the author's series, 18 were males, and the average age was 66 years for the males and 63 for the females. Seven of the patients presented with a single lesion. In eleven of the series the lesions started on the feet, in six on the hands, in three on the nose and in one on the lower part of the leg. Although ulceration and hemorrhage were considered late manifestations by Kaposi, eight of these patients had ulcerated tumours. Kaposi and other authors all give a fatal prognosis and no single healed case is reported in the literature. In this series 19 patients received treatment within two to six months of the initial symptoms. Seven patients have died. X-ray therapy was used in the treatment of 12 patients, total doses ranging between 1,000r and 4,000r (skin dose with back scatter). Daily doses were 300r to 500r. Radium was used in other cases. Radium or X rays have caused disappearance of all tumours treated. No death was due to Kaposi's sarcoma in this series.

British Medical Association News.

SCIENTIFIC.

A MEETING of the New South Wales Branch of the British Medical Association was held on July 26, 1945, at the Robert H. Todd Assembly Hall, British Medical Association House, 135, Macquarie Street, Sydney. Dr. E. A. TIVEY, the President, in the chair.

Sciatica.

Dr. W. N. LITTLE read a paper entitled "Some Further Observations on Sciatica" (see page 33).

Dr. R. A. MONEY read a paper entitled "Sciatica" (see page 37).

Dr. DOUGLAS MILLER thanked the speakers for their interesting papers. He drew attention to one point: cases of sciatica should be approached in the way in which all other cases of pain were approached—in a spirit of great caution. Dr. Miller said that many of these patients would give a heart-rending account of their sciatica, which they might even have the wisdom to trace along a particular dermatome; yet on trial their condition would prove to be only functional. Such instances were analogous to those cases of neuralgia of the fifth nerve known to all neurosurgeons, in which the patient suffered agonies of neuralgia, but after ill-advised section of the nerve complained equally severely of numbness as well as of pain. This might occur, too, with sciatic pain. It was owing to that fact that credit was claimed for many forms of treatment that were irrational, such as the use of nitric acid and the injection of local anaesthetic agents. One wondered even whether the ritualistic manipulations that were described might not have to attribute their good effects to a psychogenic origin. Careful appraisal of the pain was important; one consulting-room interview was not sufficient. Dr. Miller said that a great many cases occurred in the army; this fact might possibly explain why there were so few patients in civilian hospitals—a large proportion of the sciatica-bearing population might be in the services. Dr. Miller said that he had had the opportunity to observe these people under control conditions and to verify the reality of their pain. Referring to the question of trauma, he said that it did not by any means take an invariable place in the picture; on the contrary, as a cause it was exceptional. The pain seemed mostly to appear like a thief in the night; its start was insidious. The other type, however, did occur. Definite pathological findings were observed and were easy to recognize—bulging of a disk, a loose fragment lying under the nerve *et cetera*. What that fragment was, was open to discussion; was it due to degenerated *annulus fibrosus*, or was it *nucleus pulposus* proper? It was necessary to be on guard against the tendency of some surgeons to forget that the condition was localized, and at all costs to remove the intervertebral disk, even at the risk of rupturing the abdominal aorta, which had been reported in five cases. That was assuming that the pathology was rather different from what it was recognized to be; it assumed that the whole disk was abnormal and that the whole disk must be removed, and also it had been suggested that as no disk was present, it must be replaced by bone implantation. It might be necessary in some cases to attempt fusion; but in general it was not wise to replace nature's soft cushion with hard bone chips. Dr. Miller asked whether Dr. Little was not afraid of producing synthetic osteophytes by this procedure. He thought that in most cases of sciatica the pathology was simple; therefore the treatment was simple—removal of the object causing pressure on the nerve. He had operated on over 100 patients and had found that patients with disk protrusion recovered rapidly and were able to return to duty in four weeks. He had departed from the method of gradually getting them back to work after graduated physical therapy; if that method was used, patients became "back conscious", and it was easy to plant the seeds of a neurosis. It was better to treat them more or less casually, keep them in bed for two or three weeks, and then tell them to get up and get back to work as soon as possible. In favour of early conservative treatment was the fact that in many cases the trouble would settle down with treatment by immobilization in plaster of Paris. Referring to localization of the lesion, Dr. Miller said that Dr. Money had wisely stressed the danger of using a contrast medium in some cases. It was a pity that in Australia there was no such medium safer than lipiodol. In the United States of America "Pantopaque" was used extensively, and seemed to be free from the dis-

advantages of lipiodol. Localization by observation of pain, numbness and objective signs referred to a dermatome might be deceptive; the lesion might not be on the vertebral level at which one expected to find it, as there could be an associated pre-fixation or post-fixation of the plexus. It was, however, a simple enough matter to make an interlaminar exploration of two spaces if desired.

Dr. E. HASLETT FRAZER also thanked those who had presented papers. He said that he spoke from the point of view of the person who had been almost exclusively treating backache for twenty years. He also had suffered from chronic backache himself for more than that length of time, and had been treated for it in cities all over the world, Japan included, with no success whatever. He now spoke from the point of view of the physical therapist. He had treated a few thousand patients suffering from backache and a couple of hundred patients suffering from sciatica, most of the former successfully, and some of the latter unsuccessfully, but he could not remember more than two or three cases in which the diagnosis of ruptured intervertebral disk could be made. That was possibly due to ignorance of the fact that such a thing existed, until a few years previously; surely it was a very rare condition. The average patient suffering from backache with sciatica—not the intense sciatica depicted by the speakers, but acutal pain down the leg and buttock—who was unable to bear a hard seat, could almost always be relieved, and Dr. Frazer could guarantee cure of the backache; but he would not tackle the treatment of a ruptured intervertebral disk. Dr. Frazer said that during the past few weeks Dr. Money had operated on a female patient of his who had been in actual agony for over six months. Dr. Frazer had treated her for six weeks, but her physical pain and mental depression grew worse and worse, and even morphine gave her no relief. Dr. Money's operation gave her freedom from pain, and the freedom he hoped would be lasting. Dr. Miller had advocated conservative treatment and so had Dr. Money. Dr. Frazer thought it a waste of time. If an intervertebral disk was ruptured, the surgeon or neurosurgeon was the one to treat it. Psychogenic backache was common, but was not likely to be confused with pain due to rupture of an intervertebral disk, although it was always a problem to differentiate the psychological from the physical. Dr. Frazer asked Dr. Money whether there was any possibility of natural recovery of a protruding disk. There had been cases of sciatica all through the ages, and it was to be presumed that most of the patients had recovered. Dr. Frazer wondered what were the degenerative changes that took place in the posterior part of the *annulus fibrosus*. If one tissue underwent degeneration in that way, there must be some general metabolic disturbance. Dr. Frazer had himself tried to reproduce the condition in the spines of freshly killed calves and sheep, and had found it hard to do. But a veterinary surgeon had told him that it was now being recognized as fairly common in horses.

SURGEON LIEUTENANT-COMMANDER H. PRESTON WATSON said that he did not profess to be a specialist of any sort, but for the past eight years he had been working in various service and civilian hospitals, sometimes on the medical and sometimes on the surgical side. He had been much interested in the different methods by which sciatica was handled. Sometimes it was treated by the medical specialist, sometimes by the psychiatrist, sometimes by the orthopaedic surgeon, sometimes by the neurological surgeon, and in one case he had had great pleasure in referring a patient to the ear, nose and throat surgeon, owing to the presence of a septic focus. The specialist who was dealing with the case was apt to look for the lesion in which he was interested. Surgeon Lieutenant-Commander Watson had been interested to see what proportion of the patients benefited from the different types of treatment. He was convinced that in many cases of sciatica the condition would resolve or would be relieved by very different methods of treatment. This showed that a large number of cases of sciatica were in fact psychological in origin, and that the condition would respond to adequate psychotherapy however applied. The sciatica became impressed on the cortex, and had to be erased from the cortex. Commander Watson had seen some amazing results from operation on prolapsed intervertebral disk, and he thought that all those present had had the same experience. Possibly the majority of cases of sciatica were due to prolapsed intervertebral disks. But that did not mean that all these patients should be treated by operation. He had had the advantage of attending a number of Professor McMurray's clinics. Professor McMurray had recently become convinced that the condition was sometimes due to a prolapsed intervertebral disk. But he was still very con-

servative in treatment; he employed rest in bed or in a plaster cast.

Dr. Tivey, from the chair, expressed his appreciation of the papers, and the indebtedness of all those present to the speakers. Dr. Tivey said that he had been glad to hear Dr. Little and Dr. Money remark that sciatica was not a disease, but merely a symptom; he would have liked to hear a little more stress laid on the differential diagnosis of other extraneural causes of sciatic pain, such as tumours of various types and so on. He had had it brought home to him a good deal, especially in the case of men getting on in years who had sciatic pain, that their symptoms were often due to one type of malignant disease—prostatic. He felt strongly on that point, that any man, aged over fifty years, who suffered from sciatic pain for no apparent reason, even if he had no pronounced urinary symptoms, should be carefully investigated.

Dr. Little, in reply to Dr. Miller, said that he was not afraid of producing osteophytes, because nature would absorb bone chips if they were not needed. Osteophytes were due to infection or degeneration, and he had never had experience of either in the operations he had performed for repair of intervertebral disk damage; either would be a tragedy. He had heard of only two cases of puncture of the aorta; Dr. Miller had heard of more, and that terrified Dr. Little. He would be even more careful in future to keep away from the aorta. Dandy's method was to remove the whole disk and get the patient up in a week; Dr. Little felt sorry for the patient. The vertebra near a damaged disk was always mobile, and that led the surgeon to the disk. Sometimes two vertebrae were mobile, because there were two damaged disks. The fact was that these patients would continue to have lame backs if nothing was done for them. Dr. Haslett Frazer had referred to the possibility that a metabolic disturbance might cause the condition. Dr. Little thought that this was so. He wondered why the condition had become so much more prominent. Such patients in the Air Force had been seen in large numbers only during the last eighteen months or two years, although they had been watched for all along. Also a great number of lesions to the cartilage in the knee were occurring without any trauma—"bucket-handle" tears. Dr. Little was interested in Dr. Frazer's comments about horses; he thought that more might be learnt if sheep were examined *post mortem*. In reply to Dr. Tivey, Dr. Little said that the possibility of malignant disease must always be kept in mind. If X-ray examination revealed evidence of decalcification in the vertebrae, malignant disease must be looked for. He referred to a patient who presented with sciatica and was found to be suffering from malignant disease and to be in bad condition; stilboestrol was given with a view to making his last days more comfortable, and at the time of the meeting the patient had improved so much as to be able to get up and walk about.

Dr. Money, in reply, said that when he had referred to conservative treatment, he had meant more the conservative treatment of sciatica than the conservative treatment of damaged disks, though the line between the decision to operate and the decision not to operate had to be drawn on the pathological condition in the disk. It was possible to cure or to keep relieved people with an *annulus fibrosus* lesion, but not those with prolapse of a *nucleus pulposus*. It should be possible to make a disk which was only herniated rather than prolapsed go back and stay back by treatment along conservative lines or with sufficient rest either in bed or in a plaster jacket. Dr. Money agreed with Dr. Miller about the necessity for being satisfied of the reality of the pain, and for observing these patients over a considerable period. Treatment should always be commenced along conservative lines with medicines and a search for septic foci; it should not be assumed at once that such patients had a ruptured disk and that they would have to be subjected to operation. Dr. Money regretted that not sufficient attention had been paid at the discussion to the other causes of sciatica. Referring to contrast media, he said that "Pantopaque" had proved most satisfactory in New Zealand. It was a substance produced by the Eastman Kodak Company or for them, and could be injected into the spinal theca; it produced a good shadow, and was absorbed in about six weeks. None was obtainable in Sydney, to his knowledge. Dr. Money agreed with Dr. Tivey about the necessity for the elimination of malignant disease as a cause of sciatica, especially in men of middle age. Dr. Money cited the case of a man recently seen suffering from sciatica. After some time the pain moved from the distribution of the sciatic nerve and was felt in both groins. Dr. Money made a rectal examination and found some thickening, which was seen at

a sigmoidoscopic examination. He then palpated the abdomen (which felt full and doughy), and could not satisfy himself about the result of the palpation, although he thought he could feel a mass. He performed a laparotomy, and found a peculiar mass involving the whole of the mesentery of the small bowel; it was irregularly sausage-shaped and not directly connected with the induration in the pelvis. It appeared to be some form of inflammatory or malignant disease; a biopsy had been taken and the exact nature of the tissue had puzzled Professor Inglis. Dr. Money said that the patient's sciatica was possibly due to metastatic deposits extradurally from that lesion. In performing the reversed Queckenstedt test, he had been unable to produce any rise in the manometer.

NOTICE.

The General Secretary of the Federal Council of the British Medical Association in Australia has announced that the following medical practitioners have been released from full-time duty with His Majesty's Forces and have resumed or will resume civil practice as from the dates mentioned:

Dr. A. E. Colvin, Anson Street, Orange (December 1, 1945).

Dr. A. F. Hobson, 486, Old South Head Road, Rose Bay (January 14, 1946).

Dr. J. Steigrad, 135, Macquarie Street, Sydney (January 21, 1946).

Medical Societies.

MELBOURNE PÆDIATRIC SOCIETY.

A MEETING of the Melbourne Pædiatric Society was held at the Children's Hospital, Carlton, Melbourne, on June 13, 1945. Dr. H. DOUGLAS STEPHENS, the Acting President, in the chair. Part of this report was published in the issue of January 5, 1946.

Pyloric Obstruction without Tumour.

DR. BRUCE HALLOWS showed three patients on whom he had performed Rammstedt's operation for pyloric obstruction, though no pyloric tumour had been demonstrated clinically. The object in showing the patients was to obtain an expression of opinion on what should be done in such cases.

Dr. Hallows's first patient was a male child, who had been admitted to hospital on March 28, 1945, at the age of thirteen days, with a history of vomiting since two days after birth. The vomiting was projectile in type. On his admission to hospital, the heart and lungs were normal and no evidence of abdominal tumour or peristalsis was found. A basiliac meal was given, and fluoroscopic examination after four hours showed the meal to be retained in the stomach. The intravenous administration of glucose and saline solution was commenced, and a Rammstedt's operation was performed on March 30. The pylorus was found to be thickened only. Rammstedt's muscle-splitting incision was carried out, the abdomen was closed in layers and the skin edges were approximated with Michel clips. The wound healed satisfactorily and no further vomiting occurred. The child had some umbilical sepsis, but this responded to eusol and penicillin ointment. The convalescence was otherwise uneventful, and the child was discharged home on April 12, receiving feedings of breast milk complemented with a suitable cow's milk mixture. His weight on discharge from hospital was six pounds, and his present condition was satisfactory.

Dr. Hallows's second patient was a female, who had been admitted to hospital on April 1, 1945, at the age of two and a half weeks, with a history of vomiting. Various feedings had been tried, but she still continued to vomit. The vomiting occurred soon after feedings and was projectile in character. On examination, she was a thin, rather dehydrated baby. The heart and lungs were normal, and no peristalsis or abdominal tumour was found. A basiliac meal and subsequent fluoroscopic examination revealed that all the meal had passed through the pylorus. Vomiting continued, and she did not respond well to "Eumydrine". An X-ray examination of the gastro-intestinal tract on April 13 did not suggest congenital pyloric stenosis, but

favoured pylorospasm. On the same day the intravenous administration of glucose and saline solution was commenced, and on April 16 operation was performed. A right upper transverse incision was made. No tumour was found at the pylorus, but palpable thickening was present. Circular muscle fibres were divided longitudinally, the wound was closed in layers and the skin was closed with Michel clips. After operation the child had a rise in temperature and a few chest signs. Penicillin was administered, and the child made a good response. Vomiting still continued for a few days, but the condition gradually improved and she gained in weight. However, she continued to vomit occasionally, but responded to the administration of "Eumydrine". She was graded on to an "A3" feeding of three ounces every three hours seven times a day, and was discharged home on May 24. Her weight on discharge from hospital was six pounds.

Dr. Hallows's third patient was a male child, who had been admitted to hospital on May 7, 1945, at the age of five months. The baby had been quite well until two weeks prior to his admission to hospital; then he began to vomit his feedings and became weak and thin. The bowel motions were loose and the child seemed to be in pain. On his admission to hospital, the baby was grossly dehydrated with sunken eyes and depressed fontanelle. The heart and lungs were normal and no abdominal tumour was palpable. A basiliac meal was given, and after four hours, fluoroscopic examination showed that all the meal was held up at the pylorus. The intravenous administration of glucose and saline solution was commenced, and on May 9 operation was performed. A transverse incision was made in the right upper quadrant of the abdomen, and the pylorus was brought into the wound. It was of normal consistency and muscular development. The stomach was not hypertrophied. The circular muscle of the pylorus was then divided, but during division the mucosa was opened and had to be invaginated and oversewn. The wound was then sutured and the skin closed with Michel clips. Dr. Hallows said that the child was still in hospital. He had recovered from pylorospasm and was being treated as a dietetic problem. Investigation of the faeces had revealed that the total fat content was 45%, almost all of which was in the split form.

Dr. J. W. GRIEVE said that he was apparently the villain of the piece in providing some of the cases. He remembered the youngest baby. Vomiting had been projectile, peristalsis could be seen, and he thought he felt a tumour. X-ray examination revealed a "hold up" at the pylorus. The child was operated on, but no tumour was discovered. Dr. Grieve said that the case reminded him of another similar case. At operation Dr. Charles Osborn found no enlargement or thickening and proceeded no further. Later the baby began vomiting again, and several weeks later a tumour was palpated and peristaltic waves were seen. The child was sent back to hospital and successfully treated by Rammstedt's operation. Dr. Hallows had asked when pylorospasm should be dealt with surgically. Dr. Grieve could remember only one patient treated in this fashion. The baby had received all the recognized medical treatment and was going downhill, so he was submitted to operation. Convalescence was rocky, but he recovered. Dr. Grieve went on to say that Dr. Hallows had asked several difficult questions. With regard to the patients shown, Dr. Grieve said that the one thirteen days old had not received satisfactory medical treatment. The baby aged five months was rather old for surgical treatment, and with medical treatment might have done well. Operation in the other case seemed justifiable. The time at which these babies should be submitted to operation was an individual question. Dr. Grieve said that on several occasions he had seen babies with tumour, peristaltic waves and vomiting. Some of these patients had not been operated on, and had done well. It was obvious that it was difficult to divide these cases into water-tight compartments.

Dr. R. SOUTHBY said that he had seen a large number of similar cases in the out-patient department. It was a worry as to whether to persevere with medical treatment or to submit the patient to operation. For those patients "marking time" as far as vomiting was concerned, and in whom the X-ray examination revealed some "holdup", it was worth while persisting with medical treatment. Even twelve months afterwards, if these patients were followed up, they might be shown radiologically to have a dilated stomach. Possibly in later life they might suffer from dyspepsia and intermittent vomiting. Dr. Southby said that there was another group that appeared to be suffering from stenosis, but were not losing condition; he regarded these as suffering from subacute pyloric stenosis. They mostly responded to antispasmodics and settled down quite

well. Dr. Southby said that the criterion for operation was suspected pyloric stenosis in which the X-ray examination revealed a "hold up" and the baby was losing ground.

Dr. KATE CAMPBELL said that those patients not responding to medical treatment and therapeutically bankrupt must be handed over to the surgeon. It had to be remembered that nervous vomiting was on the increase. The amount of vomitus varied in this condition. Sometimes vomiting was projectile; sometimes the vomitus was of small amount and vomiting was forcible. The vomitus occasionally contained blood or mucus. Primarily it was due to a nervous imbalance. Surgical intervention was not indicated in these cases.

Dr. Hallows, in reply, thanked the speakers for their comments. It was now possible to say that the two younger babies were subjects of pyloric obstruction who had responded to division of their circular fibres. The five months old baby had a history of diarrhoea as well as vomiting, but X-ray examination revealed complete "hold up" after four hours. So the original diagnosis of gastroenteritis was revised. The child was going downhill rapidly, so operation was performed. Dr. Hallows said that each case must be considered on its merits with regard to medical treatment. He felt that medical treatment must be persistent and thorough before such patients were handed over to the surgeon.

Adrenal Carcinoma Causing Precocity.

Dr. JOHN BEOG showed a girl, aged six years, from whom he had successfully removed an adrenal tumour. The child had suffered from measles and whooping cough at the age of four years. She had fallen on her head at the age of two years and had been unconscious for about two hours. Her father and mother were well, as were two other children. Four years prior to the meeting she began to suffer from seizures. These occurred mostly at night; the head was retracted, the mouth was opened widely and filled with saliva, and there was an occasional twitching of the limbs. Consciousness was not lost, nor was control of the sphincters. Some change in her speech had been noted lately; her voice had become deeper and thicker. Pubic and axillary hairs had been noticed, the former since the age of less than twelve months. There was no mammary enlargement, and she had not menstruated.

General examination revealed the patient to be a small child with an old-looking facies, coarse black hair over the scalp and well-developed pubic hairs. There was no development of the breasts. Closer inspection of the vulva showed it to be of the adult type with considerable enlargement of the clitoris. The heart and lungs presented no clinical abnormality. The hands and feet were bluish, but warm. On abdominal palpation a smooth, rounded tumour could be felt immediately below the liver; this moved with respiration and could be pushed back and felt posteriorly with a hand placed in the loin. It was not tender, and no other abnormality was detected in the abdomen. Apart from some tonsillar enlargement, the remainder of the examination revealed no abnormality. A straight X-ray film of the abdomen revealed a large, irregularly calcified shadow just above the right kidney. X-ray examination of the skull revealed no evidence of increased intracranial pressure, nor could any bony abnormality be seen. The pituitary fossa was within normal limits. The Casoni test failed to produce a reaction. The hydatid complement fixation test failed to produce a reaction by both warm and ice-box methods. Estimation of the urinary androgens revealed fifteen milligrammes of androgen content in a twenty-four hours specimen (the normal figure for a child of six years being about four milligrammes). Perirenal air inflation and X-ray examination showed that the kidney was of normal size, and that the area of calcification lying above it was of suprarenal origin. An excretion pyelogram showed that the dye was excreted from both kidneys in normal time. On the right side the upper calyx was not visualized; this suggested that it was obliterated or compressed by the adrenal tumour. On the left side the pelvo-calyceal system and its ureter were normal. The patient's blood group was O (IV).

The patient was examined by Dr. E. Graeme Robertson, who reported that undoubtedly there was an upset of the ductless gland system, and that the attacks were probably epileptical. It was probable that they were coincidental, but they might be associated. Dr. Robertson stated that as far as he was aware, pituitary lesions did not produce premature secondary sexual development, although a pineal lesion might. Suprarenal tumours also might cause an increase in hair growth, but usually produced other symptoms as well. He added that he could probably obtain evidence of enlargement of the pineal gland by encephalography, but felt it

would rather be investigation by exclusion. However, the measure would serve to exclude a removable intracranial cause, and if it was thought desirable, he would gladly undertake it. As an initial measure thymic enlargement might be looked for, and an abdominal X-ray film taken to exclude a suprarenal mass. Dr. Begg said that Dr. Robertson's report was made prior to the discovery of the abdominal tumour. It was in response to Dr. Robertson's suggestion of a straight X-ray photograph of the abdomen that the calcified mass was discovered, and a fairly confident diagnosis of suprarenal tumour was made and operation decided upon.

Operation was performed on May 8, 1945. A right-sided incision was made in the loin running from the kidney angle more transversely than the usual kidney incision, just below the last rib. The muscle layers were divided and the perinephric fascia was exposed. The tumour could then be easily palpated in the depths of the wound, and to gain more room, the last rib was fractured upwards. The perinephric fascia was incised, and the kidney and the lower aspect of the tumour were brought into view. The former had a cup-shaped depression in its upper pole to accommodate the latter. The second portion of the duodenum and the colon were pushed forward from off the anterior aspect of the tumour, a small rent which was inadvertently made in the peritoneum being closed immediately. Without much difficulty, the tumour, which was about the size of a large orange, was enucleated, mainly by finger dissection, and delivered into the loin. The kidney was not disturbed. The mass felt cystic, but an attempt to facilitate its delivery by aspiration failed. Several areas of calcification and one area that felt like bone were noted during the manipulation. There was fairly brisk bleeding from the depths of the wound after delivery of the mass, but this was easily controlled by a pack until the vascular pedicle could be ligated and the tumour removed. No difficulty was then experienced in picking up and tying a fairly large vein running into the *vena cava*, which could be recognized in the tumour bed. In the pedicle, which was ligated, was some yellowish tissue suggestive of normal suprarenal structure. The wound was closed in layers and a drainage tube was placed in the depths of the wound. Preparations had been made for a blood transfusion, but it was not needed at the time, and the child's convalescence was comparatively smooth. Before the patient's discharge to the after-care home it was noted that the pubic hairs were growing again; they had been shaved prior to operation in the routine abdominal preparation. At present they were more sparse than before the operation. A pathological report on the tumour was furnished by Dr. Reginald Webster, who proposed to show the specimen at a subsequent meeting. This preliminary report was as follows:

Adrenal tumour composed of three lobules, two of which are very much degenerated. Calcium deposition is extensive throughout and at one pole there is a spicule of ossification. Microscopically, there is excessive vascularity, much necrosis and degeneration and calcium sand. Although there are fields in which the arrangement of the *zona fasciculata* of the adrenal is preserved, there are many aberrant cells, some of which show mitoses. The difficulty in microscopic diagnosis is the interpretation of the aberrant cells as between malignant metaplasia and degenerative change. It is very unusual for an innocent tumour (adenoma) to exhibit so much hemorrhage and necrosis, and the weight of evidence would indicate malignancy. There is no microscopic evidence that the tumour is of a mixed nature.

Dr. Begg said that he had a few pertinent remarks to make on the subject. Sex determination was probably made early in fetal life from factors which were inherent in the chromosomes of the primitive fertilized ovum. The determination was reinforced later by the appropriate secretion from the adrenal cortex, governed in turn by the adrenotropic hormone of the anterior lobe of the pituitary. It was probable that both this chromosomal determination and endocrine reinforcement were essentially bisexual, one element, either male or female, gaining dominance in both processes and the other undergoing suppression. It was interesting to note that hyperplastic adrenal glands removed in cases of virilism, as well as adenomata and carcinomata with similar secondary sex disturbances, had been shown to contain a granular deposit which stained brilliantly with Ponceau-fuchsin stain introduced by Vines. Prior to the discovery of this fuchsinophile material in the adrenal cortical cells, the histological study of these cells in cases of masculinization failed to reveal any specific pathological features, apart from those cases associated with definite

neoplasia. The appearance of these granules, and their amount, in the adrenals of those patients suffering from virilism appeared to be related to the amount of androgenic substances isolated from the resected gland, and indeed to the androgenic content of the urine. These granules were not present in the normal gland after birth; but their appearance in the adrenals of both sexes during early fetal life suggested an androgenic and therefore a masculinizing phase in the development of every normal female. With the subsidence of this phase and the reinforcement of the original female chromosomal sex preponderance by normal female adrenal secretions, sex development proceeded along normal lines. This temporary androgenic phase did, however, confer on the developing female embryo an instability not present in the male, and might account for the far greater frequency of virilism in the female than of feminization in the male.

The child presented undoubtedly showed evidence of some disturbance of her secondary sex characteristics. The evidence of virilism was less clear, but the enlargement of the clitoris, the deepening of the voice and the presence of a precocious puberty without enlargement of the breasts or history of menstruation, indicated that some masculinizing factor was at work, and the fourfold increase in the androgenic content of her urine supported this view. She was as yet too young to show the psychological changes towards the masculine sometimes seen in these cases. She could not, however, be regarded as in any sense a pseudo-hermaphrodite, and was still obviously a little girl. This meant that probably her endocrine disturbance began well after the time of her sex determination and reinforcement. In contradistinction to many reported cases of adrenalectomy for virilism, the hypertrichosis had persisted to some extent after operation, as the hair, though less in amount, had not been shed within a few days as was sometimes the case. Dr. Begg said that this fact must raise the possibility that androgenic absorption was still occurring from secondary hidden deposits. Against this view was the fact that the post-operative androgenic content of her urine had fallen from 15 milligrammes in a twenty-four hour specimen to 0.83 milligramme—a truly enormous decrease. Her epileptiform seizures must be regarded as coincidental; their presence for four years made it improbable that they were due to secondary intracranial deposits, and though one was struck in perusing the literature on this subject with the frequency with which seizures were mentioned in the history of the patient or of one of his close relatives, there appeared to be no grounds for connecting them with the endocrine disturbance. The child had continued to have seizures during the convalescent period.

Dr. B. HALLOWS apologized for Dr. J. G. Whitaker's absence. He congratulated Dr. Begg on the brilliant result obtained. This was the first successful case of the removal of an adrenal tumour, the patient surviving. Dr. Whitaker had attempted this operation on another child six months earlier, but had abandoned the procedure owing to technical difficulties and the profound shock associated with handling of the gland. The convalescence was stormy, but the patient recovered. Subsequently no decision had been reached as to whether the adrenal was abnormal or normal.

Dr. C. J. O. BROWN commented on the question of approach. In similar operations he had found that much hemorrhage occurred on division of the twelfth rib. Some years earlier he had removed the twelfth rib as an approach to the kidney area, and in this way prevented hemorrhage from the subcostal artery. Dr. Brown recommended this procedure to Dr. Begg. With regard to the effect of adrenalectomy, he recalled having removed an adrenal by accident from a woman with pyonephrosis of the kidney; the patient suffered no sequelae. He was astonished to find the normal adrenal sitting on top of the kidney when he examined the specimen afterwards.

Dr. L. WAIT said that the child had come to his clinic from Tasmania because of epilepsy. He thought of a possible pituitary tumour, but investigations on these lines gave negative results. The tumour of the adrenal was found by accident when an X-ray examination was made. He received the impression that the child's condition had improved as a result of the operation. The pubic hair was noticeably less.

Dr. J. W. GRIEVE said that precocious puberty did not necessarily mean abnormality of the adrenal or even of the pituitary. He remembered a child, aged nine months, with suprapubic hair and precocious development of the genitalia. The child was investigated thoroughly with negative results. Dr. Grieve had approached Dr. H. F. Bettinger with regard to the estimation of the androgen content of the urine; Dr.

Bettinger had presented him with an article in a 1944 journal of obstetrics and gynaecology, reporting nine patients aged under two years; the author had concluded that the condition was simply an example of precocious development without abnormality in the adrenal, pituitary or any other gland. Many of these patients had been followed for years and had developed into normal young women.

Dr. Begg, in reply, said that he remembered Dr. Whitaker's case; the patient had a hyperplastic adrenal cortex. Dr. Begg said that he would prefer to remove a tumour of this size rather than a normal gland. He was struck when performing a renal operation some days earlier by the vascularity of the adrenal. In this case no technical difficulty was experienced in the treatment of the twelfth rib during the approach; he had merely pushed it up and fractured it with his hand without dividing it. This was easy to do in children. Dr. Wait had introduced him to the case. The condition was at first thought to be of pituitary origin. Dr. Robertson had suggested a plain X-ray picture of the abdomen, and after this the mass could be demonstrated by palpation. Apparently some improvement had already been effected. Dr. Begg was interested in Dr. Grieve's observation that these people were normal on reaching adult life.

(To be continued.)

Post-Graduate Work.

COURSES AT MELBOURNE DURING 1946 FOR MEDICAL GRADUATES.

THE Melbourne Permanent Post-Graduate Committee announces that the following courses for medical graduates will be held during 1946. Particulars regarding fees, times and places may be obtained from the Secretary of the Committee at the Royal Australasian College of Surgeons Building, Spring Street, Melbourne (telephone: Central 1855), unless other directions are given. Fees for service and ex-service personnel may be defrayed by the Commonwealth Government, in accordance with the terms of its "Rehabilitation Plan". Before any rehabilitation training is commenced, the executive officer of the State Medical Coordination Committee should be consulted. This officer is Dr. H. Boyd Graham, and he may be found at the British Medical Association Buildings, 426, Albert Street, East Melbourne (telephone: JM 1442). Entries, accompanied by the appropriate fee, should be in the hands of the Secretary two weeks before the commencement of each course.

Continuous Refresher Courses.

Commencing on February 4, continuous whole-day refresher courses will be conducted on Mondays, Tuesdays, Thursdays and Fridays until the end of November, 1946.

In an eight weeks' course there will be fourteen full days at the Royal Melbourne Hospital, seven at the Alfred Hospital, seven at Saint Vincent's Hospital, and four at the Children's Hospital—28 medical sessions, 28 surgical sessions and eight paediatric sessions.

Courses for M.D. (Part II) and M.R.A.C.P.

A series of clinical lecture-demonstrations designed for a higher qualification in medicine will be conducted from February 5 until the end of November, 1946.

Courses for M.S. (Part II) and F.R.A.C.S.

Courses suitable for candidates presenting themselves for Part II of the examination for the degree of master of surgery or for admission as Fellows of the Royal Australasian College of Surgeons will be conducted by the Royal Australasian College of Surgeons. Particulars may be obtained from the Secretary of the College, Spring Street, Melbourne (telephone: J 2002).

Intensive General Refresher Courses.

A course designed for general practitioners will be conducted from June 3 to June 15, 1946. This will be followed by an intensive refresher course, with or without residence as desired, at the Women's Hospital, from June 17 to June 29, 1946. Both these courses may be repeated in the latter half of the year if the demand is sufficient.

University Courses for Various Degrees and Diplomas.

Classes have been arranged at the Departments of Anatomy, Physiology and Pathology of the University of Melbourne, suitable for candidates presenting themselves for Part I of the examinations for the degrees of doctor of medicine and master of surgery, or for the diplomas in gynaecology and obstetrics, laryngology and otology, psychiatric medicine and medical radiology.

The classes will commence approximately on March 14 and continue until June, 1946. They may be repeated in the latter half of the year if the demand is sufficient.

Other Courses.

Commencing on March 14 and continuing until April 11, 1946, a course of five lecture-demonstrations will be conducted on modern methods and technique in teaching. Courses in orthopaedics, genito-urinary diseases, psychiatry, modern diagnostic methods *et cetera* will be conducted throughout the year in Melbourne, and at country centres week-end courses will be held.

THE MELBOURNE PERMANENT POST-GRADUATE COMMITTEE'S PROGRAMME FOR FEBRUARY.

THE Melbourne Permanent Post-Graduate Committee announces the following programme for February, 1946.

Continuous Refresher Course.

The following whole-day refresher classes will be conducted on four days of each week, surgical classes in the mornings (10 a.m. to 12 noon) and medical classes in the afternoons (2 p.m. to 4 p.m.):

Monday, February 4, at the Royal Melbourne Hospital: morning, Mr. E. Hughes; afternoon, Colonel H. H. Turnbull.

Tuesday, February 5, at the Alfred Hospital: morning, Mr. L. Ball; afternoon, Dr. M. Ashkenasy.

Thursday, February 7, at Saint Vincent's Hospital: morning, Mr. F. J. Colahan; afternoon, Dr. J. Horan.

Friday, February 8, at the Children's Hospital: morning, Lieutenant-Colonel J. B. Colquhoun; afternoon, Dr. J. W. Grieve.

Monday, February 11, at the Royal Melbourne Hospital: morning, Brigadier W. A. Hales; afternoon, Dr. C. H. Fitts.

Tuesday, February 12, at the Alfred Hospital: morning, Mr. C. J. O. Brown; afternoon, Dr. C. Sutherland.

Thursday, February 14, at Saint Vincent's Hospital: morning, Mr. C. G. Shaw; afternoon, Dr. J. G. Hayden.

Friday, February 15, at the Royal Melbourne Hospital: morning, Mr. C. W. B. Littlejohn; afternoon, Dr. I. Maxwell.

Monday, February 18, at the Royal Melbourne Hospital: morning, Mr. V. Hurley; afternoon, Dr. K. D. Fairley.

Tuesday, February 19, at the Royal Melbourne Hospital: morning, Mr. Paul Jones; afternoon, Dr. W. W. S. Johnston.

Thursday, February 21, at Saint Vincent's Hospital: morning, Mr. F. F. D'Arcy; afternoon, Dr. T. Heale.

Friday, February 22, at the Children's Hospital: morning, Mr. R. Howard; afternoon, Dr. R. Southby.

Monday, February 25, at the Royal Melbourne Hospital: morning, Dr. R. Kaye Scott; afternoon, Dr. R. P. McMeekin.

Tuesday, February 26, at the Alfred Hospital: morning, Mr. C. Hembrow; afternoon, Dr. L. B. Cox.

Thursday, February 28, at Saint Vincent's Hospital: morning, Mr. R. H. Hadley; afternoon, Dr. W. J. Newing.

This course will be continued throughout the year. The fee for each eight weeks is twenty guineas. Classes are to be limited to a size convenient for clinics, and during 1946 priority will be given to service and ex-service medical officers, but the course is open to all members of the British Medical Association.

Course for M.D. (Part II) and M.R.A.C.P.

A series of clinical lecture-demonstrations designed for a higher qualification in medicine will be conducted on Tuesday afternoons from 2.15 p.m. The syllabus for February is as follows:

February 5, at the Royal Melbourne Hospital: by Dr. B. Lawton on "Peripheral Vascular Disease".

February 12 at the Alfred Hospital: by Dr. J. A. MacLean on "Anæmia".

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February 19 at Saint Vincent's Hospital: by Dr. R. M. Biggins on "Acute Nephritis".

February 26 at the Royal Melbourne Hospital: by Colonel D. J. Thomas on "Rheumatic Heart Disease".

The fee for each two months of this course is four guineas. Here also classes will be limited and priority given to service and ex-service medical officers.

Enrolments for these two courses should be made with the Secretary, Post-Graduate Committee, College of Surgeons, Spring Street, Melbourne, C.I.

POST-GRADUATE STUDY IN ENGLAND.

THE following extract from a letter received by the Melbourne Permanent Post-Graduate Committee from the Fellowship of Post-Graduate Medicine, London, is published for the information of medical practitioners.

... As soon as it is once more practicable, we hope to resume our pre-war procedure of producing in advance a year's programme of work. At present, however, we are still in rather a state of chaos. The end of both wars came quicker than was expected, and it is taking a long time to unwind the war machine. The rate of demobilization of the teaching staffs of the hospitals is very slow, and until the majority of them are back at their civilian work, and until the hospitals have been repaired (or in some cases practically rebuilt) after their experience of enemy action, post-graduate facilities will remain curtailed. We can still only arrange courses as and when the opportunity arises, though we shall increase the number and variety as soon as we can.

At present we are advising our overseas enquirers to postpone their visits to this country for a few more months if they possibly can. Accommodation, especially in London, is an appalling problem until more house repairs have been done, and until the Government has de-requisitioned the many hotels and boarding houses which they took over for offices—at present they show few signs of making any move out of these premises! We are very anxious to see our overseas doctors over here once more—we have sadly missed them during the past six years—but at the same time we do not want them to waste their time and money by having to cope with high prices and lack of the work they need. . . .

Correspondence.

RENAL FAILURE AND ANOXIA.

SIR: In a recent article Maegraith *et alii* (1945) have proposed that the title "renal anoxia" be applied to the renal failure occurring in a variety of conditions "generally secondary to acute peripheral circulatory failure".

As my name (Tomb *c*) has been prominently and inaccurately identified by the authors with the proposed title, I shall be much obliged if I may be permitted to make some observations concerning it.

In 1941 (Tomb *a*) I first put forward the suggestion that the anuria of cholera is due to anoxia in these words: "The frequent failure of intravenous saline injections to restore and maintain the circulation in cholera, as well as to re-establish the secretion of urine after collapse has existed for two or more hours, is thus seen to be due to irreparable damage to the capillary endothelium, as well as to the epithelial cells of the kidney tubules, from lack of oxygen."

In the same year (Tomb *b*) and also in 1942 (Tomb *c*) I gave reasons for believing that the anuria of "crush injury" is, like the anuria of cholera, due to anoxia.

In the first of these two articles I wrote: "It would therefore appear that, in so-called 'crush injury', the renal failure and associated histological changes in the tubules are caused solely by oxygen-want (as suggested by Sir L. Hill), the epithelial cells of the convoluted tubules being even more sensitive to want of oxygen than the endothelium of the blood capillaries itself."

In 1942 (Tomb *d* and *e*) I gave a detailed analysis of the causes of anoxia and suggested that the anuria found in blackwater fever, incompatible blood transfusion and pernicious anaemia, as well as in cholera and "crush injury", is due to anoxia.

In 1943 these various communications were finally summarized by me (Tomb *f*) in an article in which I

concluded that "the anuria and renal changes met with in 'crush-injury' are manifestations of anoxia due to traumatic shock, and are identical in origin with those found in acute hemolyses, e.g., incompatible blood transfusion and blackwater fever, in pernicious anaemia, severe hemorrhage and the collapse of cholera, all of which are due to anoxia."

In the 1943 (fourth) editions of both Beatty and Dixon's and Boyd's textbooks of pathology the importance of anoxia is stressed as a cause of fatty degeneration, particularly of the secretory cells of the kidney and liver.

Of anoxia, Boyd (1943) writes as follows: "There are two great causes of fatty degeneration, (i) the action of toxins and (ii) the lack of oxygen. It is possible that the first acts by virtue of interfering with the proper oxygenation of cells. Insufficient oxygenation is seen in severe anemias both primary and secondary." Beatty and Dixon also write to the same effect.

Anuria may be caused, apart from obstructions to the urinary tract, (i) by a fall in arterial blood pressure (Winton, 1937) and (ii) by damage to the secretory epithelial cells of the renal convoluted tubules from (a) anoxia and (b) inorganic or organic poisons, including bacterial and viral toxins. (Leftwich, 1920; Moon, 1944.)

Since circulatory failure is only one of the many causes of anoxia (Tomb *d* and *e*) and anoxia is only one cause of renal tubular degeneration and failure (Boyd, 1943; Beatty and Dixon, 1943), it is not possible accurately to attribute to anoxia the renal failure common to the varied conditions enumerated by Maegraith and his associates in their article.

Yours, etc.,

J. WALKER TOMB.

Sydney,

December 6, 1945.

Bibliography.

- B. G. Maegraith, R. E. Havard and D. S. Parsons (1945): "Renal Syndrome", *The Lancet*, September 8, page 293.
J. Walker Tomb: (a) "Cholera and Uræmia", *The Journal of Tropical Medicine and Hygiene*, July 1, 1941, page 89.
(b) "Collapse and Renal Failure", *THE MEDICAL JOURNAL OF AUSTRALIA*, November 15, 1941, page 569.
(c) "Cholera and Anuria", *Transactions of the Royal Society of Tropical Medicine and Hygiene*, January 31, 1942, page 229.
(d) "Crush Injury and Anoxia", *British Medical Journal*, October 24, 1942, page 495 (correspondence).
(e) "Shock and the Sympathetic Nervous System", *THE MEDICAL JOURNAL OF AUSTRALIA*, November 28, 1942, page 483.
(f) "Crush Injury and Anoxia", *New Zealand Medical Journal*, April, 1943, page 75.
J. M. Beatty and W. E. C. Dixon: "Text Book of Pathology", 1943, pages 157-197.
W. Boyd: "Text-Book of Pathology", 1943, pages 23-65.
F. R. Winton: *Physiological Reviews*, 1937, Number 17, page 408.
R. W. Leftwich: "An Index of Symptoms", Seventh Edition, 1920, page 303.
V. H. Moon: "Analysis of Shock", *British Medical Journal*, June 10, 1944, page 773.

THE LEGACY CLUB.

SIR: On behalf of Sydney Legacy, I will be grateful if you will afford me space to make known to medical practitioners the service aimed at for our wards, and the manner in which "Legacy" can cooperate with them.

An effort is made to examine medically every child on its admission as a ward of the club. In the case of some, living at a distance from Sydney, this may be difficult at times. If a child is found to be unhealthy, or deficient in some way, inquiry is made to discover if the disability is properly under treatment, and if not, steps are taken to initiate and supervise treatment. In addition an attempt is made to make periodic health reviews of all wards.

A proportion of the club's wards are war orphans and are provided by the Repatriation Department with continuous medical attention through friendly society lodges. However, many of them are not entitled to repatriation benefits, and it is the policy of the club to have them all on the lodge list of a doctor.

There is a large number of doctors in general practice as well as specialists who have generously offered to help in the medical care of our children. Through their good offices "Legacy" is able to arrange consultations and give help when the family doctor or lodge doctor wants it. "Legacy's" aim is to cooperate and not to interfere with the family doctor. A telephone message to the club's almoner at any time will secure that help and cooperation.

Yours, etc.,

ERIC P. BLASHKI,
Chairman, Medical Committee,
Sydney Legacy.

193, Macquarie Street,
Sydney,
January 3, 1946.

Naval, Military and Air Force.

CASUALTIES.

ACCORDING to the casualty lists received on January 12, 1946, Major G. E. Jose, Woodville, South Australia, previously reported "deceased, cause unknown", is now stated to have died of illness whilst a prisoner of war.

According to the casualty lists received on January 14, 1946, Colonel D. C. Pigdon, Narre Warren, Victoria, previously reported "recovered prisoner of war", is now reported "died of illness".

According to the casualty list received on January 15, 1946, Captain J. A. Whitfield, Bingara, New South Wales, previously reported "dangerously ill", has now died of illness.

Australian Medical Board Proceedings.

NEW SOUTH WALES.

THE undermentioned have been registered, pursuant to the provisions of the *Medical Practitioners Act, 1938-1939*, of New South Wales, as duly qualified medical practitioners:

- Stanton-Cook, Peter Alan, M.B., B.S., 1945 (Univ. Sydney), Royal South Sydney Hospital, Zetland.
Symonds, Barry Cyril, M.B., B.S., 1945 (Univ. Sydney), Royal South Sydney Hospital, Zetland.
Symonds, Lloyd Saul, M.B., B.S., 1945 (Univ. Sydney), Brisbane General Hospital, Brisbane, Queensland.
Taylor, Benjamin John, M.B., B.S., 1945 (Univ. Sydney), Prince Henry Hospital, Little Bay.
Tindale, Harold Patrick, M.B., 1945 (Univ. Sydney), Newcastle Hospital, Newcastle.
Walker, Maxwell Spencer, M.B., B.S., 1945 (Univ. Sydney), Saint Vincent's Hospital, Darlinghurst.
Walker, Reginald Lavis, M.B., B.S., 1945 (Univ. Sydney), Marrickville District Hospital, Marrickville.
Weekes, Hazel Claire, M.B., 1945 (Univ. Sydney), 15, Hercules Street, Chatswood.
Williams, Evan Ross Landeg, M.B., B.S., 1945 (Univ. Sydney), Brisbane General Hospital, Brisbane, Queensland.
Wyke, Barry Darrell, M.B., B.S., 1945 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.
Yates, Tom Owen Richard, M.B., B.S., 1945 (Univ. Sydney), Ryde District Soldiers' Memorial Hospital, Eastwood.
Breheny, Peter Eugene, M.B., B.S., 1939 (Univ. Melbourne), Repatriation Commission, Sydney.
Hickey, Patrick Walter, M.B., B.S., 1943 (Univ. Melbourne), Parramatta District Hospital, Parramatta.
Smith, Keith Viner, M.B., B.S., 1939 (Univ. Adelaide), Department of Pathology, University of Sydney, Sydney.
Stoddard, Alan, M.B., B.S., 1943 (Univ. London), c.o. Macdonald Hamilton and Company, Sydney.

QUEENSLAND.

THE undermentioned have been registered, pursuant to the provisions of *The Medical Acts, 1939 to 1940*, of Queensland, as duly qualified medical practitioners:

- Guinane, James Vincent, M.B., B.S., 1927 (Univ. Sydney), Brisbane Mental Hospital, Goodna, Queensland.
Hayward, George Murray, M.B., B.S., 1943 (Univ. Melbourne), c.o. Leichhardt Hotel, Bolsoner Street, Rockhampton.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

- Hemphill, Woodrow Sanford, M.B., B.S., 1942 (Univ. Sydney), 35, Elizabeth Street, Mayfield, Newcastle.
Richards, Charles Rowland Bromley, M.B., B.S., 1939 (Univ. Sydney), 80, Kensington Road, Summer Hill.

Books Received.

"Rorschach's Test: II. A Variety of Personality Pictures", by Samuel J. Beck, Ph.D., with a foreword by Roy R. Grinker, Lieutenant-Colonel, M.C.; 1945. New York: Grune and Stratton, Incorporated. 9" x 6", pp. 414. Price: \$5.00.

"The 1945 Year Book of Radiology", Diagnosis: edited by Charles A. Waters, M.D., associate editor, Whitmer B. Firor, M.D.; Therapeutics: edited by Ira I. Kaplan, B.Sc., M.D.; 1945. Chicago: The Year Book Publishers, Incorporated. 9" x 6", pp. 464, with many illustrations. Price: \$5.00.

Diary for the Month.

- JAN. 17.—Victorian Branch, B.M.A.: Executive Meeting.
JAN. 22.—New South Wales Branch, B.M.A.: Council Meeting.
JAN. 23.—Victorian Branch, B.M.A.: Council Meeting.
JAN. 24.—South Australian Branch, B.M.A.: Council Meeting.
JAN. 25.—Queensland Branch, B.M.A.: Council Meeting.
JAN. 31.—South Australian Branch, B.M.A.: Scientific Meeting.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmah United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phoenix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia. All Public Health Department appointments.

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